DEPARTMENT OF THE ARMY TECHNICAL MANUAL

TM 11-5835-212-15

DEPARTMENT OF THE AIR FORCE MANUAL

TO 31S3-2UN-181

OPERATOR, ORGANIZATIONAL, FIELD AND DEPOT MAINTENANCE MANUAL

SOUND RECORDER-REPRODUCER SET RD-173/UN

This reprint includes all change in effect to the time of publication changes 1, 2 and 4.

DEPARTMENTS OF THE ARMY AND THE AIR FORCE

SEPTEMBER 1961

Operator, Organizational, Field and Depot Maintenance Manual
SOUND RECORDER-REPRODUCER SETS RD-173/UN AND RD-173A/UN

TM 11–5835-212-15
TO 31S3-2UN-181
CHANGES No. 1

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D. C., *22 October 1962*

TM 11-5835–212–15/TO 31S3-2UN–181, 13 September 1961, is changed as indicated so that the manual also applies to the following equipment:

Nomenclature	*Order No.*
Sound Recorder-Reproducer Set RD-173A/UN	NObs 84257

Change the title of the manual to: SOUND RECORDER-REPRODUCER SETS RD-173/UN AND RD-173A/UN.

Page iv, after paragraph 10, add:

11. Differences in Models

Item	Sound Recorder-Reproducer Set RD-173/UN	Sound Recorder-Reproducer Set RD-173A/UN
Dimensions	16 3/8" x 18 1/8" x 12".	14 7/8" x 16 7/8" x 12 1/16".
Powerline frequency.	60 cps	50 or 60 cps
Capacitor C28	Not included	Included
Capstan sleeve	Not included	Included
Microphone	2" x 2 3/4" x 3 1/4"	2" x 2 5/8" x 4 5/8"

Page 1, paragraph 1.1, below the title, add:

Note. Official nomenclature followed by (*) is used to indicate all models of the equipment item covered in this manual. Thus Sound Recorder-Reproducer Set RD–173(*)/UN represents Sound Recorder-Reproducer Sets RD-173/UN and RD-173A/UN.

Page 8, paragraph 1.2.1. After last sentence, add: The RD–173A/UN can be used with either 50 or 60 cps at 115 volts; the RD-173/UN can only be used with 60 cps at 115 volts.

Page 5, paragraph 3.1. Delete the first sentence and substitute: Installation of the recorder consists of setting the RD–173/UN on a level surface of at least 16 by 19 inches, with overhead clearance of 27 inches, and the RD–173A/UN on a level surface of at least 15 by 15 inches with overhead clearance of 27 inches, and connecting the power cord to a convenient receptacle.

Page 6, paragraph 5.1, lines 2 and 5. Delete "RD-173/UN" and substitute: RD-173(*)/UN.

Page 8, paragraph 5.4, line 11. Delete "RD-173/UN" and substitute: RD-173(*)/UN.

Page 16, paragraph 5.8.3.2, right-hand column.

Line 5. Change "(pin 1)" to: (pin 7).

Line 10. Change "(pin 2)" to: (pin 8).

Page 19, paragraph 7.1.2. Delete second sentence.

Page 23. Delete paragraphs 7.2.2.1.1 through 7.2.2.1.6 and substitute:

7.2.2.1.1 Carefully turn recorder on end, accessories compartment down. Remove four screws around the outside of the top panel (12, figs. 23 and 26), Slide the amplifier and mechanism assembly out several inches and detach the speaker plug. Complete removal of the amplifier and mechanism assembly.

Note. To gain access to the amplifier components for inspection of electronic trouble, follow the procedure given in paragraph 7.2.2.1.2.

For mechanical trouble, follow the procedures given in paragraphs 7.2.2.1.3, 7.2.2.1.4, and 7.2.2.1.5.

7.2.2.1.2 Remove 12 screws to remove bottom cover.

7.2.2.1.3 Remove recorder head cover (18) by removing one screw (19).

7.2.2.1.4 Remove all knobs and two screws (17) under control knob. Move plastic cover (16) about 1/16 inch toward front and lift off.

7.2.2.1.5 Remove three screws (14) and two screws (13) in panel, and lift panel from mechanism assembly.

Page 27. Delete section 8 and substitute:

Section 8. FOURTH ECHELON TESTING PROCEDURES

8.1 General

Testing procedures are prepared for use by Signal field maintenance shops and Signal service organizations responsible for fourth echelon maintenance of signal equipment to determine the acceptability of repaired signal equipment. These procedures set forth specific requirements that repaired signal equipment *must* meet before it is returned to the using organization. The testing procedures may also be used as a guide to test equipment repaired at third echelon if the proper tools and test equipments are available. A summary of the performance standards is given in paragraph 8.8. Comply with the instructions preceding the body of each chart before proceeding to the chart. Perform each step in sequence. Do not vary the sequence. For each step, perform all the actions required in the *Test equipment control settings* and *Equipment under test control settings* columns; and then perform each specific test procedure and verify it against its performance standard.

8.2 Test Equipment and Other Equipment Required

All test equipment and other equipment required to perform the testing procedures given in this section are listed in the following charts and are authorized under TA 11–17 Signal Field Maintenance Shops, and TA 11-100 (11-17), Allowances of Signal Corps Expendable Supplies for Signal Field Maintenance Shop, Continental United States, or TOE 11–158D, Signal Depot Company, and TA 11-101 (11-158), Allowances of Signal Corps Expendable Supplies for Signal Depot Company, or are repair part items of the subject equipment authorized for stockage at fourth echelon levels.

a. Test Equipment.

Nomenclature	Federal stock No.	Technical manual
Audio Oscillator TS–382(*)/U[a]	6625–192–5094	TM 11–6625–261–12
Electronic Voltmeter ME–30(*)/U[b]	6625–669–0742	TM 11–6625–320–12
Output Meter TS–585(*)/U[c]	6625–244–0501	TM 11–5017
Spectrum Analyzer TS–723–(*)/U[d]	6625–668–9418	TM 11–5097

[a] Indicates TS 382A/U, TS 382B/U, TS 382D/U, TS-382E/U, and TS 382F/U.
[b] Indicates ME 30A/U, ME 30B/U, and ME-30C/U.
[c] Indicates TS 585B/U and TS 585C/U.
[d] Indicates TS 723/U, TS-723A/U, and TS 23B/U.

b. Other Equipment.

Equipment	Federal stock No.	Technical manual
Cord CD–1252/U (2 ea)	5995–284–6306	None.
Adapter Connector UG–514/U.	5935–351–4620	None.
Cord CG–409/U	5995–503–0470	None.

8.3 Special Requirements

The labeling of certain controls differs on Audio Oscillator TS–382A/U from that on Audio Oscillators TS-382B/U, TS-382D/U, TS-382E/U, and TS-382F/U. References to controls in the charts refer to the latter. If the TS-382A/U is used to perform these tests, use the control that corresponds to that given in the test procedure.

8.4 Physical Tests and Inspections

a. Test Equipment and Material. None.

b. Test Connections and Conditions. Make no connections to recorder-reproducer during this test.

c. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	None	Controls may be in any position.	*a.* Check the VOLUME and TONE controls for smooth operation and freedom from binding throughout the limits of travel.	*a.* All controls should operate freely without binding.
			b. Check the SPEED SELECTOR, RECORD-LISTEN, control knob, ON-OFF, and SPEAKER switches and control knob for proper operation.	*b.* Same as step *a* above.
2	None	Same as above	*a.* Inspect all connectors, mechanical assemblies, fuses, and terminal boards for damage, missing parts, or incorrect fuse ratings.	*a.* There should be no missing parts or damage serious enough to hamper proper operation. Fuse should be 2 amperes.
			b. Inspect unit for condition of finish and panel markings.	*b.* Surfaces originally painted should not show bare metal. Panel markings should be legible.
3	*MX-1292/PAQ* *a.* Connect mercury vapor lamp. *b.* Install wide transmission filter in the lamp.	Controls may be in any position.	Turn on the mercury vapor lamp and expose the portion of the equipment that has been repaired or disturbed to the direct rays of the lamp.	All repaired or disturbed electrical components and chassis surfaces will be covered. There must be *no* varnish on switch contacts or moving parts of mechanical assemblies. *Note.* Moisture-fungiproofing varnish glows gray-green under the rays of a mercury vapor lamp.

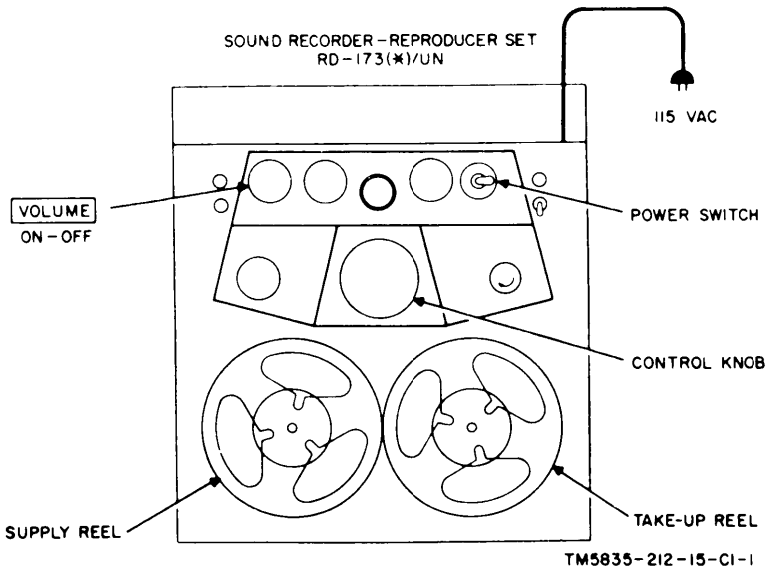

Figure 21.1 (Added) *Mechanism test.*

8.5 Mechanism Test

a. Test Equipment and Material. 1 reel tape and 1 empty reel (part of RD–173(*)/UN).

b. Test Connections and Conditions. Connect unit to 115 volts AC. Thread tape through head for normal operation (fig. 21.1).

c. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	None	Control knob: STOP. VOLUME ON-OFF: ON.	*a.* Set control knob to FORWARD and then to FAST FORWARD while observing takeup reel shaft speed.	*a.* Rotation should be clockwise. Observe shaft speed for later reference.
			b. Set control knob back to STOP	*b.* Takeup shaft speed should decrease almost instantaneously and then stop.
			c. Set control knob to REWIND	*c.* Supply reel shaft should rotate counterclockwise at about the same speed as takeup shaft rotated at FAST FORWARD in step *a* above.

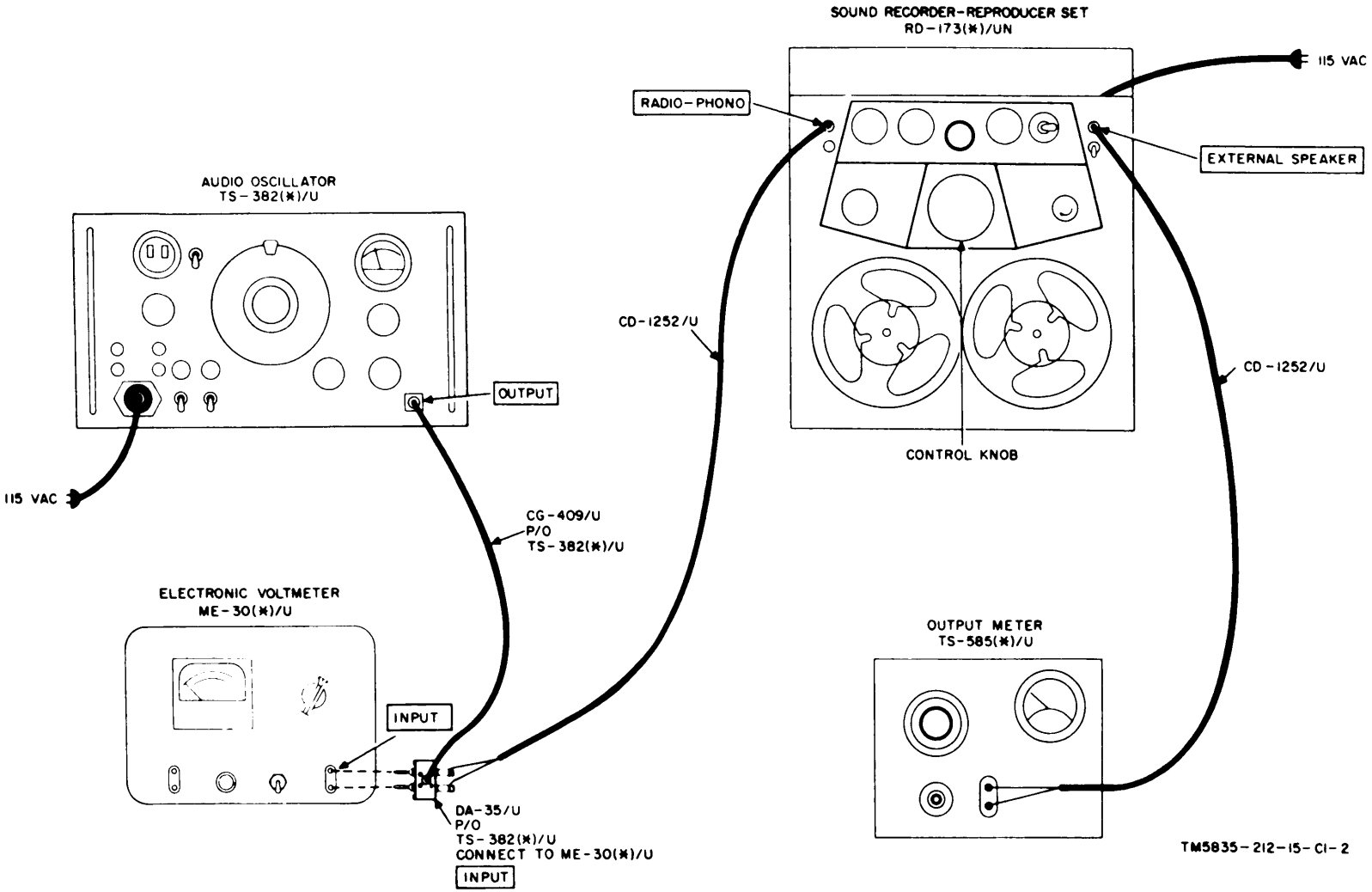

Figure 21.2 (Added) *Frequency response test.*

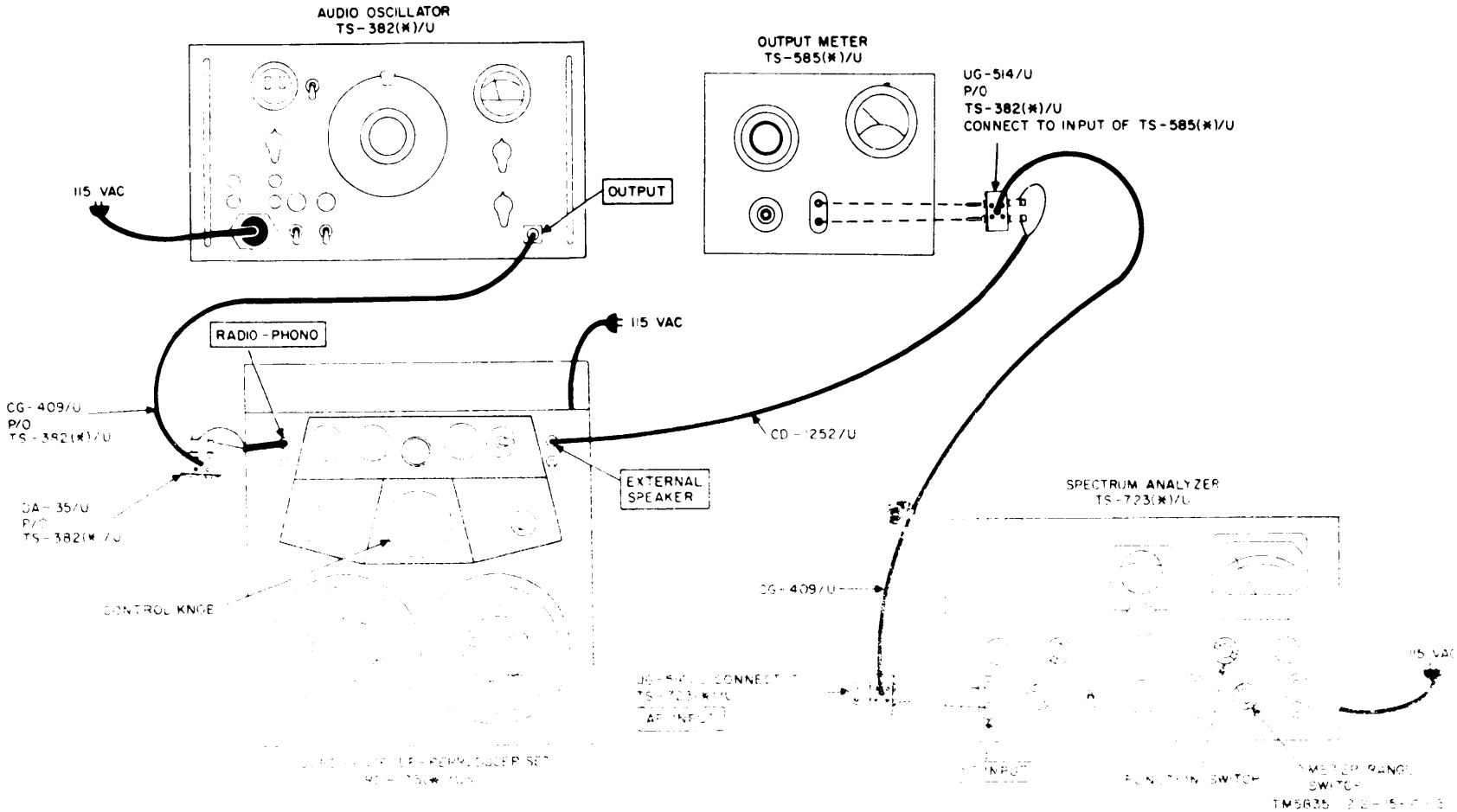

Figure 21.3 (Added) *Distortion and output level test.*

8.8 Test Data Summary

a. Frequency Response.

7 1/2 *I.P.S.*

200 to 5,000 cps at +10 db ±2 db

3 3/4 *I.P.S.*

200 to 3,000 cps at +10 db ±2 db

b. Distortion.

(1) 7 1/2 *I.P.S.* At 100, 200, and 5,000 cps distortion will not exceed 5% at an output power of 2.2 watts.

(2) 3 3/4 *I.P.S.* At 100, 200, and 3,000 cps distortion will not exceed 5% at an output power of *2.2* watts.

c. Mechanism Test. Takeup reel shaft shall rotate clockwise.

Figure 22. (Fold-out). Add note 10.

10. IN THE RD-173A/UN, CAPACITOR C28 IS ADDED ACROSS RESISTOR R19.

Figure 25. (Fold-out). At the top right-hand side under "REVISIONS" chart add:

Note. THE DIMENSIONS OF THE RD-173A/UN ARE 14 7/8 X 16 7/8 X 12 3/16 INCHES.

Figure 28. (Fold-out). At the right-hand side under "REVISIONS" chart add:

Note. IN THE RD-173A/UN, C28 IS MOUNTED OVER ITEM (222) ON THE RESISTOR BOARD ASSEMBLY (165).

Figure 29. Add note 12.

12. IN THE RD-173A/UN, C28 IS PLACED BETWEEN Rl9 AND R20 WITH ONE END OF C28 SOLDERED TO THE TOP END OF R19 AND ITS OTHER END TIED TO THE 2D LUG (FROM LEFT BOTTOM) OF #3 SECTION OF FUNCTION SWITCH S2.

By Order of the Secretaries of the Army and the Air Force:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:
J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

CURTIS E. LEMAY,
Chief of Staff, United States Air Force.

Official:
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USATC Inf (2)
USATC FA (2)
USATC Armor (2)
USAOMC (2)
Svc Colleges (2)
Br Svc Sch (2)
GENDEP (2) except
Atlanta GENDEP (none)
Sig Sec, GENDEP (5)
Sig Dep (12) except
Sacramento Sig Dep (17)
WRAMC (1)
USA Trans Tml Cored (1)
Army Tml (1)
POE (1)
OSA (1)
1st GM Bde (5)
USMA (5)
USA SPWAR Cen (5)
BAMC (5)
Brooke Gen Hosp (5)
Madigan Gen Hosp (5)
Ord Tk-Autmv Cored (5)
Def Gen Sup Cen (5)
Frankford Ord Arsenal (5)
Granite City Engr Dep (5)
USAEPG (2)
AFIP (1)
AMS (1)
Army Pictorial Cen (2)
EMC (1)
USA Strat Comm Cored (4)
USASSA (25)
USASSAMRO (1)
USA RCARIB Sig Agcy (1)
USA Sig Msl Spt Agcy (13)
Sig Fld Maint Shops (3)
Def Log Svc Cen (1)
USA Corps (3)
JBUSMC (2)
Mt Ranier Ord Dep (5)
Savanna Ord Dep (5)
Sierra Ord Dep (5)
Sioux Ord Dep (5)
Units org under fol TOE: 2 copies
each except as indicated)
11–7
11–16
1 1–57
11-97
11-98
11–117
11-155
11–157
11-500 (AA-AE) (4)
11–557
11-587
11–592
1 1–597
12-17
30-14
30–25
30-26
30-27
30–28
30-29
30-500 (AA-AE)

NC: State AG (3).

USAR: None.

For explanation *of* abbreviations used, see AR 320-50.

Changes in force: C 1 and C 2

TM 11-5835-212-15
Change No. 2

TECHNICAL MANUAL

Operator, Organizational, Field and Depot Maintenance Manual,

SOUND RECORDER-REPRODUCER SETS RD-173/UN AND RD-173A/UN

TM 11-5835-212-15
Change No 2

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASGINGTON 25, D. C., *11 September* 1963

TM 11-5835-212-15/TO 31S3-2UN-181, 13 September 1961, is changed as follows:

Note. The parenthetical reference to previous Changes (example: page 7 of C 1) indicates that pertinent material was published in that change.

Page 1. Add paragraphs 1.1.3 and 1.1.4 after paragraph 1.1.2.

1.1.3. Index of Publications

Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to this equipment. DA Pam 310-4 is a current index of technical manuals, technical bulletins, supply bulletins, lubrication orders, and modification work orders which are available through publications supply channels. The index lists the individual parts (-10, -20, –35P, etc) and the latest Changes to and revisions of each equipment publication.

1.1.4. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions in TM 38-750.

b. Report of Damaged or Improper Shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR *700-58* (Army), NAVSANDA Publication 378 (Navy), and AFR 71-4 (Air Force).

c. Reporting of Equipment Manual Improvements. The direct reporting by the individual user of errors, omissions, and recommendations for improving this manual is authorized and encouraged. DA Form 2028 (Recommended changes to DA technical manual parts lists or supply manual 7, 8, or 9) will be used for reporting these improvements. This form will be completed in triplicate using pencil, pen, or typewriter. The original and one copy will be forwarded direct to: Commanding Officer, U. S. Army Electronics Materiel Support Agency, ATTN: SELMS-MP, Fort Monmouth, N. J. One information copy will be furnished to the individual's immediate supervisor (e.g., officer, noncommissioned officer, supervisor, etc).

Page 18. Add Section 6.1 after section 6:

Section 6.1. MAINTENANCE INSTRUCTIONS

6.1-1. Scope of Maintenance

The maintenance duties assigned to the operator and organizational repairman of Sound Recorder-Reproducer Sets RD-173/UN and RD-173A/UN are listed below, together with a reference to the paragraphs covering the specific maintenance functions.

a. Daily preventive maintenance checks and services (par. 6.1-4).

b. Weekly preventive maintenance checks and services (par. 6.1-5).

c. Cleaning (par. 6.1-6).

d. Quarterly preventive maintenance checks and services (par. 6.1-9).

e. Touchup painting (par. 6.1-10).

6.1-2. Preventive Maintenance

Preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, to reduce downtime, and to assure that the equipment is serviceable.

a. Systematic Care. The procedures given in

TM 11-6625-32&12 Operator's and Organizational Maintenance Manual: Voltmeter, Meter ME-30A/U and Voltmeters, Electronic ME-30B/U and ME-30C/U.

TM 38-750 The Army Equipment Record System and Procedures.

By Order of the Secretary of the Army:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:
J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

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USCONARC (5)
USAMC (5)
ARADCOM (2)
ARADCOM Rgn (2)
OS Maj Comd (3)
OS Base Comd (2)
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Armies (2)
Corps (2)
USA Corps (3)
USATC AD (2)
USATC Engr (2)
USATC Inf (2)
USATC Armor (2)
USASTC (5)
Instl (2) except
Ft Monmouth (65)
Svc Colleges (2)
Br Svc Sch (2) except
GENDEP (OS) (2)
Sig Dep (OS) (12)
Sig Sec, GENDEP (5)
Army Dep (2) except
Ft Worth (8)
Lexington (12)
Sacramento (28)
Tobyhanna (12)
USA Elct RD Actv, White Sarde (13)
USA Elct RD Actv, Ft Huachuca (2)
USA Trans Tml Cored (1)
Army Tml (1)
POE (1)
USAOSA (1)
AMS (1)
WRAMC (1)
AFIP (1)
Army Pic Cen (2)
USA Mbl Spt Cen (1)
USA Elct Mat Agcy (12)
Chicago Proc Dist (1)
USARCARIB Sig Agcy (1)
Sig Fld Maint Shop (3)
Units org under fol TOE (2 cy ea UNOINDC):
11-7
11-16
11-57
11-97
11-98
11-117
11-155
11-157
11-500(Tms AA-AC) (4)
11-557
11-587
11-592
11497
12-17
19-35
19-36
19-217
19-500(Tma AA-AE)
30-14
30-17
30-25
30-26
30-27
30-28
30-29
30-500(Tms AA-AE)
32-56
32-510(Tms AA-AC)

NG: State AG (3).
USAR: None.
For explanation of abbreviations used see AR 320-50.

Page 27. Paragraph 8.6 (page 7 of C 1). In step No. 1, "Test procedure" column, item c, add the following after the last sentence: Adjust the TONE control for maximum treble.

Paragraph 8.7 (page 11 of C 1). In step No. 1, "Test procedure" column, item *b,* add the following after the last sentence: Adjust the TONE control for maximum treble.

In step No. 2, "Performance standard" column, delete item *h* and substitute: TS-723 (*)/U should not indicate more than 8% distortion (0.8 on upper 0-1.0 scale).

Add section 9 after section 8.

Section 9. DEPOT INSPECTION STANDARDS

9.1. Applicability of Depot Inspection Standards

The tests outlined in this section are designed to measure the performance capability of a repaired equipment. Equipment that is to be returned to stock should meet the standards given in these tests.

9.2. Applicable References

a. Repair Standards. Applicable procedures of the Army depot performin this test and its general standards for repaired signal equipment form a part of the requirement for testing this equipment.

b. Modification Work Orders. Perform all modification work orders (MWO) applicable to this equipment before making the test specified. DA Pam 310-4 lists all available MWO's.

9.3. Test Facilities Required

The following equipment is required for depot testing:

9.4 General Test Requirements

All the test should be performed under the following conditions

a. Check to see that the power source is 115 volts, 60 cycles ac.

b. Use virgin or completely degassed tape for recording purposes.

c. Measure the audio oscillator's output voltage with Voltmeter, Meter ME 30/U

d. Unless otherwise indicated, conduct all electrical test at cal tests at a speed of 7 1/2 inches per second.

e. Make signal inputs for all electrical test at RADIO-PHONO jack J-2.

f. Measure audio output across external test at jack J-3 with the speaker switch on.

9.5. Tape Speed Test

The following test method will be used in determining the proper tape speed.

a. With the equipment operating at slow speed (3 3/4 ips) an 18 3/4-foot length of tape will pass over the recording head in 60 seconds ± 3.

b. With the equipment operating at high speed (7 1/2 ips), an 18 3/4 - foot length of tape will pass over the recording head in 30 seconds ± 2.

c. The feed reels will not discharge a loop of tape before stopping. There must be no creeping of tape when a loop is intentionally created.

9.6. Power Output Test

To test the recorder-reproducer set for proper power output, proceed as follows:

a Connect the equipment as shown in figure 21.3. Do not connect the spectrum analyzer.

b. Tune the audio oscillator to a frequency of 1,000 cycles. Adjust the output for 0.6 volt.

c. set the TONE control to maximum treble. Set the VOLUME control to the point where the level indicator closes but does not overlap. Record the audio oscillator's output on several feet of tape.

d. Play back the recorded signal. The output (as indicated on the output meter) must be no less than 2.2 watts.

9.7. Frequency Response Test

To test the frequency response of the tape recorder, proceed as follows:

a. Connect the equipment as shown in figure 21.2.

b. Adjust the audio oscillator for a 0.6 volt output at 1,000 cycles.

c. Set the TONE control to maximum treble. Set the VOLUME control to where level indicator just closes but does not overlap.

d. Record the following frequencies, maintaining the input level to where the level indicator just closes but does not overlap: 1,000, 200, 500, 2,000, 5,000, and 7,000 cycles.

e. Reproduce the recording, adjusting the 1,000-cycle signal for a 10-db output. The output at the remaining frequencies will not vary by more than ±2 db except that at 7,000 cycles it will not vary by more than ±4 db.

9.8. Distortion

To test the distortion of the tape recorder proteed as follows:

a. Connect the spectrum analyzer as shown in figure 21.3.

b. Record the following frequencies at an input of 0.6 volt; 200, 1,000, and 3,000 cycles.

c. Set the TONE control to maximum treble, adjust VOLUME control to the position where the level indicator just closes but does not overlap.

d. Reproduce recorded signals, maintaining an output of 2.2 watts at each frequency. The total harmonic distortion will not exceed 8% when measured at each recorded frequency.

9.9. Signal-to-Erasure Ratio Test

To test the signal to erasure ratio, proceed as follows:

a. Set the TONE control to maximum treble, adjust the VOLUME control to a position where the level indicator just closes but does not overlap, with an input of 0.6 volt at a 1,000 cycles.

b. Erase a portion of the recorded signal. The signal portion and the erased portion will be reproduced with the volume control set to maximum.

c. The erased portion will be no less than 30 db down from the recorded signal level.

9.10. Operational Test

To give the tape recorder an operational test, proceed as follows:

a. Use a microphone and record on slow and fast speed.

b. Play back the recorded portion at normal output.

c. The reproduced signal will be clear and intelligible on the internal speaker.

Add appendix I after section 9.

APPENDIX I

REFERENCES

Following is a list of applicable references available to the operator and repairman of sound Recorder-Reproducer Set RD-173/UN and RD-173A/UN.

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
TM 9-213	Painting instructions for Field Use.
TM 11-5017	Output Meters, TS-585A/U, TS-585B/U, TS-585C/U, and TS-585D/U.
TM 11-5097	Spectrum Analyzers TS-723A/U, TS-723B/U, and TS-723C/U.
TM 11-5835-212-12P	Operator and Organizational Maintenance Repair Parts and Special Tools Lists and Maintenance Allocation Chart, Recorder-Reproducer, Sound RD-173A/UN.
TM 11-5835-212-35P	Field and Deport Maintenance Repair Parts and Special Tool Lists, Recorder-Reproducer, Sound RD-173A/UN.
TM 11-6625-261-12	Operator's and Organizational Maintenance Manual: Audio Oscillators TS-382A/U, TS-382B/U, TS-382D/U, TS-382E/U, and TS-3882F/U.

paragraphs 6.1-4,6.1-5, and 6.1-6 cover routine systematic care and cleaning essential to proper upkeep and operation of the equipment.

b. Preventive Maintenance Checks and Services. The preventive maintenance checks and services charts (pars. 6.l-4 and 6.l-5) outline functions to be performed at specific intervals. These checks and services are to maintain Army electronic equipment in a combat serviceable condition; that is, in good general (physical) condition and in good operating condition. To assist operators in maintaining combat serviceability, the charts indicate what to check, how to check, and what the normal conditions are. The *References* column lists the illustrations, paragraphs, or manuals that contain detailed repair or replacement procedures. If the defect cannot be remedied by the operator, higher echelon maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38-750.

6.1-3. Operator's Preventive Maintenance Checks and Services Periods

Operator's preventive maintenance checks and services of Sound Recorder-Reproducer Sets RD-173/UN and RD-173A/UN are required daily and weekly. Paragraphs 6.1-4 and 6.1-5 specify the items to be checked and serviced. In addition to the routine daily and weekly checks and services, the equipment should be rechecked and serviced immediately before going on a mission and as soon after completion of the mission as possible.

6.1-4. Daily Preventive Maintenance Checks and Services

Sequence No.	Item	Procedure	References
1	Completeness	Check the equipment for completeness.	TM 11-5835-212-12P.
2	Hardware	During cleaning operation (item 3), inspect for damaged, miming, or loose hardware, controls, and reels.	
3	Cleaning	Remove dirt, grease, oil, and moisture from the case, control panel, tape reels, recording-reproducing and erase heads, and other mechanical controls or knobs.	Para 6.1-6.
4	Knobs and switches. . .	While making the operating checks (item 5), observe that the action of each knob and switch is smooth and free of external or internal binding.	
5	Operation	Check equipment in accordance with paragraphs 4.1.1 and 4.12. During operation, be alert for any unusual performance or condition.	

6.1-5. Weekly Preventive Maintenance Checks and Services

Sequence No.		Procedure	References
1	Preservation	Inspect all exposed surfaces for signs of chips, cracks, rust, corrosion, or mildew. If these conditions are present, refer to higher echelon for repair.	
2	Capstan	Check and clean capstin (83, fig. 7).	
3	Cables and cords.	Inspect cables and cords for frays, loose connections, deterioration, and breaks.	

6.1-6. Cleaning

Inspect the exterior of the recorder-reproducer set. The exterior surfaces should be clean, and free of dust, dirt, grease and fungus

a. Remove dust and loose dirt with a clean soft cloth.

Warnings: **Cleaning compound is flammable and its fumes are toxic. Provide adequate ventilation.** ***Do not*** **use near a flame.**

b. Remove grease, fungus, and ground-in dirt from the case; use a cloth dampened (not wet) with cleaning compound (FSN 7930-395-9542).

c. Remove dust or dirt from plugs and jacks with a brush.

d. Clean the panels and control knobs, use a soft clean cloth. If dirt is difficult to remove, dampen the cloth with water; mild soap may be used for more effective cleaning.

6.1–7. Organizational Preventive Maintenance

a. Organizational preventive maintenance is the systematic care, inscction, and servicing of equipment to maintain it in servicable condition, prevent breakdowns, and assure maximum operational capability. Preventive maintenance is the responsibility of all echelons concerned with the equipment and includes the inspection, testing, and repair or replacement of parts, subassemblies, or unit that inspection and test indicate would probably fail before tile next scheduled periodic service. Preventive maintenance checks and services of Sound Recorder-Reproducer Sets RD-173/UN and RD-173A/UN at the second echelon level are made at monthly intervals unless otherwise directed the commanding officer.

b. Maintenance forms and records to be used and maintained on this equipment are specified in TM 38-750.

6.1-8. Quarterly Maintenance

Quarterly preventive maintenance checks and services on Sound Recorder-Reproducer Sets RD–173/UN and RD-173A/UN are required. All deficiencies or shortcomings will be recorded in accordance with the requirements of TM 38–750. perform all the checks and services listed in the quarterly preventive maintenance checks and services chart (par. 6.1-9) in the sequence listed. Adjustment of the maintenance interval must be made to compensate for any unusual operating conditions Equipment maintained in a standby (ready for immediate operation) condition must have quarterly preventive maintenance checks and services performed on it. Equipment in limited storage (requires service before operation) does not require quarterly preventive maintenance.

6.1–9. Quarterly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Completeness	See that the equipment is complete.	TM 11–5835–212–12P
2	Publications	See that all publications are complete, serviceable, and current.	DA Pam 310–4
3	Modifications	Check DA Pam 310–4 to determine if new applicable MWO's have been published. All URGENT MWO's must be applied immediately. All NORMAL MWO's must be scheduled	TM 38–750 and DA Pam 310–4
4	Lubrication	Lubricate the equipment in accordance with paragraph 7.1.4.	Para 7.1.4.
5	Preservation	Inspect all exposed surfaces for signs of chips, cracks, rust, corrosion, or mildew. If these conditions are present, refer to paragraph 6.1–10.	
6	Capstan	Check and clean the capstan (83, fig. 7).	
7	Cables and cords	Inspect cables and cords for frays, loose connections, deterioration, and breaks.	
8	Hardware	During cleaning operations (item 9) inspect for damaged, missing, or loose hardware, controls, and reels.	
9	Cleaning	Remove dirt, grease, oil, and moisture from case, control panel, tape reels, recording-reproducing and erase heads, and other mechanical controls or knobs.	Para 6.1–6.
10	Interior	Clean interior of cases and chassis units.	
11	Wiring	Check all internal wiring and components for damage.	
12	Screws and bolts	Tighten all loose screws and bolts.	
13	Knobs and switches	While making the operating checks (item 14), observe that the action of each knob and switch is smooth, and free of external or internal binding.	
14	Operation	Check the equipment in accordance with paragraphs 4.1.1 and 4.1.2. During operation, be alert for any unusual performance or condition.	

6.1-10. Touchup Painting Instructions

Clean rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to the applicable cleaning and refinishing practices in TM 9-213.

Page 19. Delete paragraph 7.1.3.

Change in force: C 1, C2, and C4

TM 11-5835-212-15
***C 4**

Operator, Organizational, Field and Depot Maintenance Manual
SOUND RECORDER-REPRODUCER SETS RD-173/UN AND RD-173A/UN

CHANGE
No. 4

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *10 August 1964*

TM 11-5835-212-15, 13 September 1961, is changed as follows:

Note. The parenthetical reference to a previous change (example: page 1 of C 2), indicates that pertinent material was published in that change.

Page 1, paragraph 1.1.4c (page 1 of C 2). Delete the fourth sentence and substitute: The original and one copy will be forwarded direct to Commanding General, U.S. Army Electronics Command, ATTN: AMSEL-MR-MP-P Fort Monmouth, N.J. 07703.

Page 24, delete paragraph 7.2.2.2.9 and substitute:

7.2.2.2.9. Adjusting Record Level Indicator

a. Set up equipment for recording (para. 6.2).

b. Connect an audio oscillator to the RADIO-PHONO input connector.

c. Adjust the audio oscillator output to 1,000 cps at 1.5 volts.

d. Set the TONE control to TREBLE (maximum clockwise) and adjust the VOLUME control for a 40-milliwatt output at the SPEAKER jack across a 3-ohm impedance.

e. Adjust R-27 so that the record-level indicator eye just closes without overlapping.

Page 27, paragraph 8. 6C (as changed by C 3, 13 May 64). "Performance standard" column. Delete step No. 2C and substitute:

c. Output should not vary more than ± 4 db on TS-585 (*) /U (between 6 and 12 db on upper scale).

Paragraph 8.8 (as changed by C 3, 13 May 64). Make the following changes:

Subparagraph *a.* Delete the second and third lines and substitute:

7 1/2 *Ips*

200 to 7,000 cps at 10 db ± 4 db

Subparagraph b(1). Change "5%" to: 8%,

Paragraph 9.3 (as changed by C 3, 13 May 64). Add the following after the last item in the chart.

Item	Technical manual	Common name
Flutter Indicator ID-851/U,	TM 11-6760-212-12	Flutter indicator.
Oscilloscope AN/USM-81.	TM 11-6625-219-12	Oscilloscope.

* This change supersedes C 3, 13 May 1964.

Paragraph 9.4b (as changed by C 3, 13 May 64). Delete "virgin or"

Delete subparagraph *f* and substitute:

f. Measure audio output across OUTPUT jack J-3 with speaker switch at ON position, using the output meter adjusted for 3-ohm impedance.

Paragraph 9.6 (as changed by C 3, 13 May 64). Make the following changes:

Subparagraph. Change "figure 21.3" to: figure 21.2. Delete the second sentence.

Subparagraph c. Delete the second sentence and substitute: Set VOLUME control for a 35-milliwatt output on the output meter.

Paragraph 9.7 (as changed by C 3, 13 May 64). Make the following changes:

Subparagraph *c*. Delete the second sentence and substitute: Set VOLUME control for a 35-milliwatt output on the output meter. Delete subparagraph *d* and substitute:

d. Record the following frequencies at an audio oscillator output of 0.6 volt without readjusting the VOLUME and TONE controls: 1,000, 200, 500, 2,000, 5,000, and 7,000 cps

Subparagraph *e*. Delete the second sentence and substitute: The output of the remaining frequencies should not vary by more than ± 4 db.

Paragraph 9.8 (as changed by C 3, 13 May 64). Delete and substitute:

9.8. Distortion

To measure the distortion of the tape recorder, proceed as follows:

a. Connect the spectrum analyzer as shown in figure 21.3.

b. Set the TONE control to maximum treble. Adjust the VOLUME control for a 35-milliwatt output on the output meter with an input signal of 1,000 cps at 0.6 volt.

c. Record the following frequencies at an input of 0.6 volt without readjusting the VOLUME and TONE controls: 1,000, 2,000, 3,000, 5,000, and 7,000 cps.

d. Reproduce the recorded 1,000-cps signal at an output level of 2.2 watts. Reproduce each of the remaining recorded frequencies without readjusting the VOLUME and TONE controls. The harmonic distortion at each recorded frequency should not exceed 8 percent.

e. To monitor the output of the tape recorder for noise, connect the oscilloscope across the output.

Add paragraph 9.8.1 after paragraph 9.8 (as added by C 3, 13 May 64).

9.8.1. Flutter Test

To measure the flutter of the tape recorder, proceed as follows:

a. Connect the equipment as shown in figure 21.3, except that the flutter indicator should be used in place of the spectrum analyzer.

b. Set the TONE control to maximum treble and adjust the VOLUME control for a 35 milliwatt output on the output meter with an input of 0.6 volt at 3,000 cps.

c. Record the 3,000-cps signal on a 5-minute section of tape.

d. Measure and calculate the low- and high-frequency flutter error on the flutter indicator.

e. The total flutter error should not exceed 1 percent.

Paragraph 9.9 (as changed by C 3, 13 May 64). Delete subparagraph a and substitute:

a. Set the TONE control to maximum treble and adjust the VOLUME control for a 35-milliwatt output with an input of 0.6 volt at 1,000 cps.

Appendix I (page 5 of C 2). Add the following to the references.

TM 11-6626-219-12	Operator's and Organizational Maintenance Manual: Oscilloscope AN/USM-81.
TM 11-6760-212-12	Operation and Organizational Maintenance Manual: Flutter Indicator ID-851/U.
TB SIG 355-1	Depot Inspection Standard for Repaired Signal Equipment.
TB SIG 355-2	Depot Inspection Standard for Refinishing Repaired Signal Equipment.
TB SIG 356-3	Depot Inspection Standard for Moisture and Fungus Resistant Treatment.

By Order of the Secretary of the Army:

HAROLD K. JOHNSON,
General, United States Army,
Chief of Staff

Official:

J. C. LAMBERT,
Major General, United States Army
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USASTC (2)
USATC Armor (2)
USA SW Cen (2)
USWACC (2)
USATC AD (2)
Army Pic Cen (2)
USA Desert Test Cen (2)
USAPA (2)
MAAG:
  China (2)
  Vietnam (2:
USARAL (2)
USARMISH:
  Venezuela (2)
Sig Fld Maint Shops (1)
1st USASA Fld Sta (1)
USACECDA:
  Ft Huachuca (1)
  Ft Monmouth (1)
USAEMA (6)
USAEMSA (15)
llth Air Assault Div (8)
Chicago Proc Dist (1)
Fort Hunchuca (1)
Fort Lee (2)
Fort Myer (2)
WSMR (1)
USAERDL (2)
USAELRDL (6)
CRREL (2)
Edgewood Arsenal (2)
Detroit Arsenal (2)
Frankford Arsenal (2)
1st FA Msl Bde (2)
Natl Censorship Sta (2)
MM Sig Spt Fac (2)
1st GM Bde (2)
Oakland A Tml (5)
Units org under fol TOE:
  11-158 (2)
  11-587 (2)
  11-592 (2)
  11-597 (2)

NG: State AG (3).
USAR: None.

For explanation of abbreviations used, see AR 220-60.

SAFETY WARNING

The attention of officers and personnel is directed to Chapter 65 of the Bureau of Ships Manual or superseding instructions on the subject of safety precautions to be observed.

This equipment employs voltages which are dangerous and may be fatal if contacted. Extreme caution should be exercised when servicing the equipment.

While every practicable safety precaution has been incorporated, the following rules must be strictly observed:

DISASSEMBLY AND SERVICING OF THE EQUIPMENT MUST BE PERFORMED BY QUALIFIED AND AUTHORIZED SERVICING PERSONNEL ONLY.

DON' T SERVICE OR ADJUST ALONE -

UNDER NO CIRCUMSTANCES SHOULD ANY PERSON ATTEMPT TO SERVICE OR ADJUST TH1S EQUIPMENT, WHEN REMOVED FROM ITS CASE, WITHOUT THE IMMEDIATE PRESENCE OR ASSISTANCE OF ANOTHER PERSON CAPABLE OF RENDERING FIRST AID.

KEEP AWAY FROM LIVE CIRCUITS

Personnel must observe all safety regulations at all times. Do not change tubes or make adjustments inside equipment with high voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors. To avoid casualties always remove power and discharge and ground circuits prior to touching them.

VOLTAGES OVER 300 VOLTS SHALL BE MEASURED AS FOLLOWS:

1. Reenergize the equipment. Ground terminals to be measured to discharge any capacitors connected to these terminals. (See Note f.)

2. Connect meter to terminals to be measured using a range higher than the expected voltage.

3. WITHOUT TOUCHING METER OR TEST LEADS, energize the equipment and read the meter.

4. Reenergize the equipment. Ground the terminals connected to the meter before disconnecting meter.

NOTES:

a. MAKE SURE YOU ARE NOT GROUNDED whenever you are adjusting equipment or using measuring equipment.

b. In general, USE ONE HAND ONLY when servicing live equipment.

c. If test meter must be held or adjusted while voltage is applied, GROUND the case of the meter before starting measurement and DO NOT touch the live equipment or personnel working on live equipment while you are holding the meter. Some moving vane type meters should not be grounded. These should not be held during measurements.

d. DO NOT FORGET that high voltages MAY BE PRESENT across terminals that are normally low voltage, due to equipment breakdown. Be careful even when measuring low voltages.

e. DO NOT use test equipment known to be in poor condition.

f. High voltage high capacity capacitors should be discharged with a grounding stick with approximately 10 ohms in series with the grounded line. Where neither terminal of a capacitor is grounded, short capacitor terminals to each other.

RESUSCITATION

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION BY THE PRONE PRESSURE METHOD SHALL BE PROMINENTLY DISPLAYED IN EACH SPACE IN WHICH THE EQUIPMENT IS USED. POSTERS MAY BE OBTAINED UPON REQUEST TO THE BUREAU OF MEDICINE AND SURGERY.

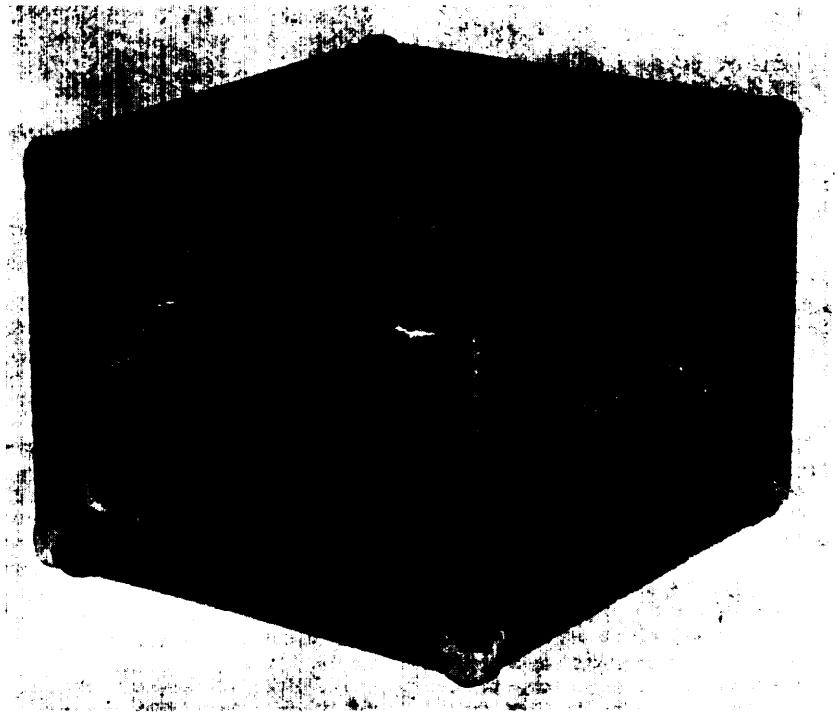

Figure 1. Type RD-173/UN Sound Recorder-Reproducer

GENERAL DATA

1. COMPONENT LIST

Qty.	Description	Navy Type	BuShips Stock No.	Dimensions (Inches)	Weight
1	Recorder	RD-173/UN		16-3/8 X 18-1/8 X 12	45
1	Microphone			2 X 2-3/4 X 3-1/4	
1	Attachment Cord			36	
2	Plastic Base Recording Tape and Reel (Boxed)			l / 2 x 7 x 7	
1	Empty Reel			3/8 X 7	
1	Spare Parts (Boxed)			3 x 3 x 6	
2	Technical Manual	NAVSHIPS 365-2493		3/8 X 8-3/4 X 11 -1/4	

2. TUBE COMPLEMENT

Symbol	Type	Qty. per Equip.
V-1	5879	1
V -2	5751	1
V-3	5726/6AL5	1
V-4	6V6	1
V-6	605/6AQ5W	1
V-6	6E5	1
V-7	5Y3WGTB	1

3. INPUT POWER REQUIREMENTS

115 V 60 Cps Single Phase Control Position	watts
Rewind	100
stop	100
Forward (Record)	106
Forward (Reproduce)	100
Fast Forward	100

4. INPUTS

Input	Location	Impedance	Source	Voltage Limits
RADIO-PHONO	Front Panel	20K Ohms	Radio-Phono	2 V max
MIC	Front Panel	500K Ohms	Microphone	2 V max

5. OUTPUTS

output	Location	Impedance	Level	Listening Equipment
Monitor	Internal	3.2 Ohms	2.5 W	Internal Speaker
Ext. Speaker	Front Panel	3.2 Ohms	2.5 W	External Speaker

6. RECORDING TIME AND MEDIUM

Recording is accomplished on magnetically coated plastic base tape of 1/4 inch width and 1215 feet minimum length wound on seven inch diameter plastic reels. Two tracks can be recorded on a tape with a minimum recording time of 60 minutes for each track at a tape speed of 3.75 inches per second, or a minimum recording time of 30 minutes for each track at a tape speed of 7.5 inches per second.

7. FREQUENCY RESPONSE

The frequency response of the Recorder-Reproducer at full recording level is substantially as shown in figure 2.

8. DISTORTION

The maximum overall harmonic distortion of the Recorder-Reproducer is 5% at 2-1/2 watts output.

9. REMOTE CONTROL

A hole in the front of the case is provided for insertion of a finger tip control rod to permit remote starting and stopping of the equipment.

10. MICROPHONE TECHNIQUE

When monitoring the signal with the internal speaker, the microphone should be as far as practical from the speaker and to the side of the speaker axis to prevent acoustical feedback. For best results when recording voice, the microphone should be held about one inch to the side of the mouth and in such a position that the sound travels across the face of the microphone, instead of directly into the microphone.

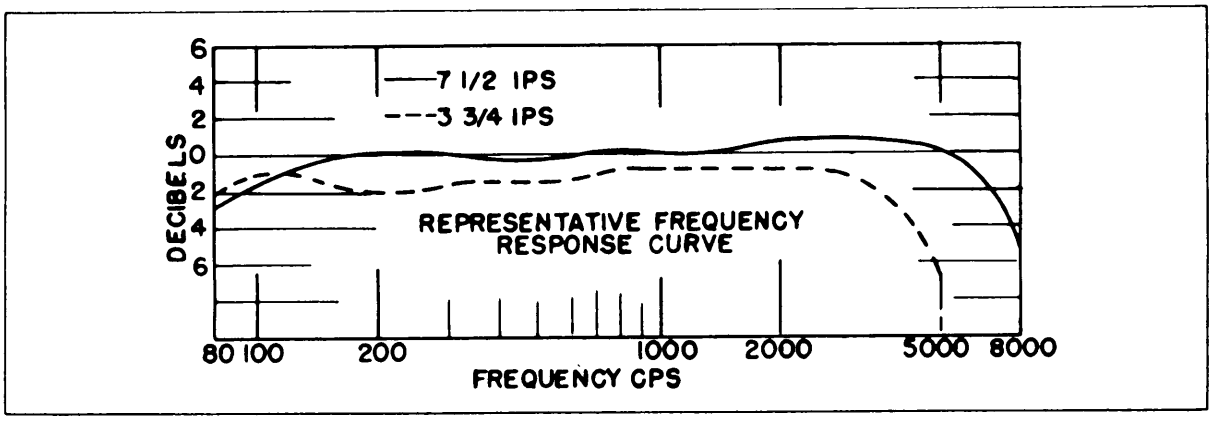

Figure 2. Representative Frequent y Response Curve

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LIST OF ILLUSTRATIONS

MASTER DRAWINGS

SECTION 1
INTRODUCTION

1.1 INTRODUCTION

1.1.1 This publication contains installation, operation, and maintenance instructions for the Type RD-173/UN Sound Recorder-Reproducer.

1.1.2 The RD-173/UN is a self-contained portable sound recorder-reproducer (see figure 1). The equipment, hereafter called the recorder, consists of a dual speed tape transport mechanism. a record-reproduce-erase head, a six-inch permanent magnet speaker, and an amplifier, mounted in a convenient fabric covered plywood carrying case, and accessories consisting of a microphone, attachment cord, finger tip control rod, two reels of blank tape, an emptv reel. and a carton of spare parts.

1.2 APPLICATION

1.2.1 The RD-173/UN is a portable instrument, de-

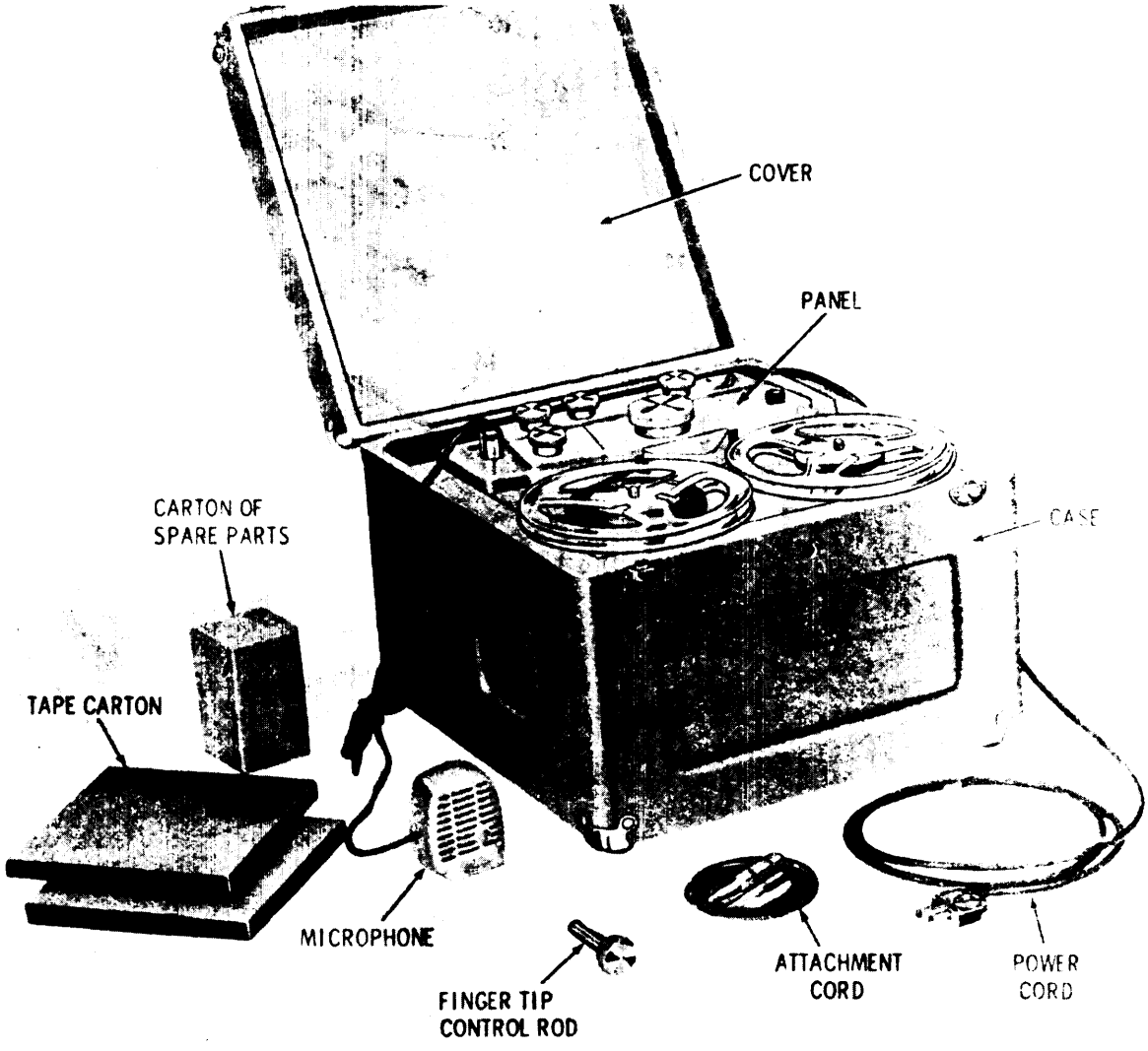
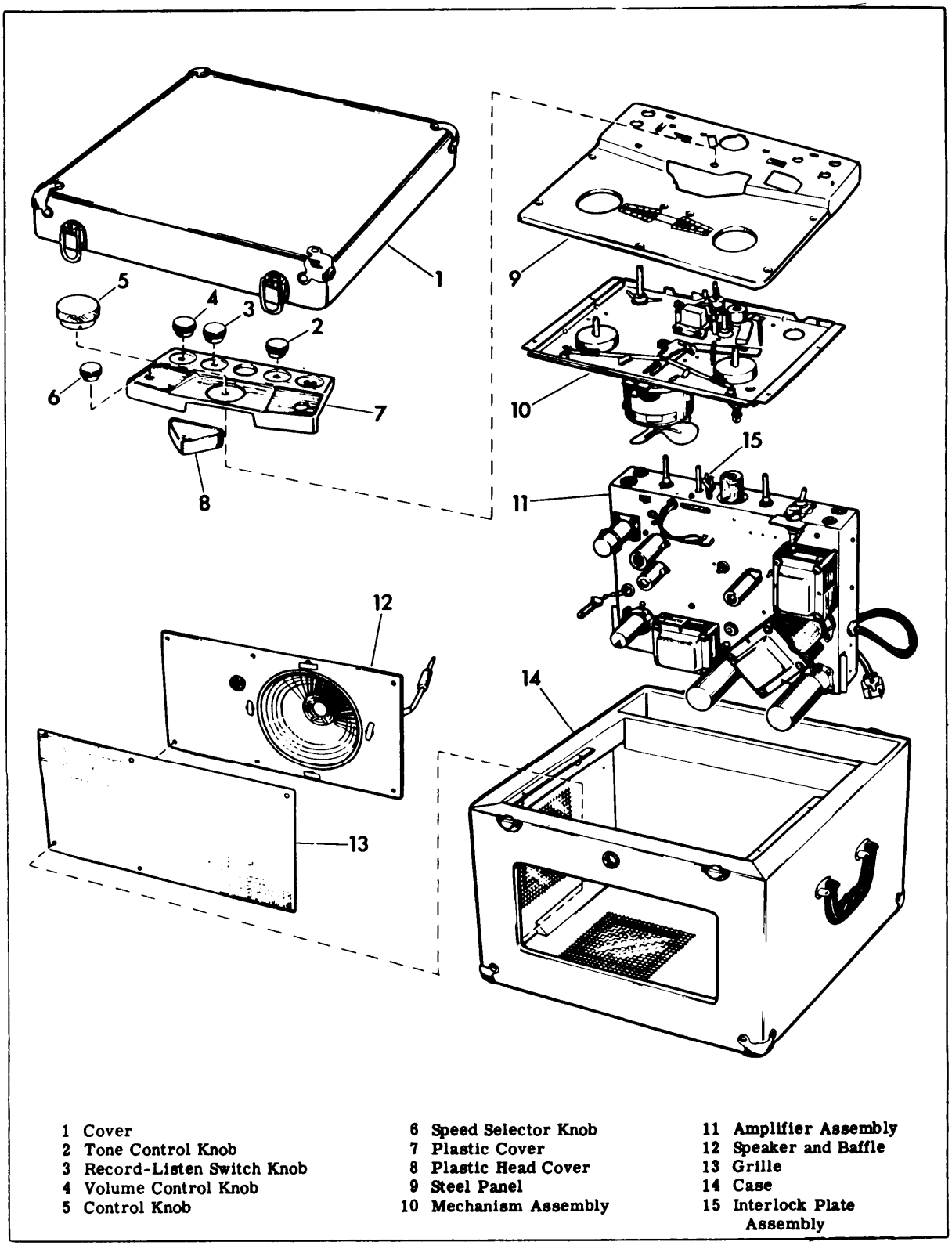


Figure 3. Type RD-173/UN Sound Recorder-Reproducer and Accessories



1 Cover
2 Tone Control Knob
3 Record-Listen Switch Knob
4 Volume Control Knob
5 Control Knob
6 Speed Selector Knob
7 Plastic Cover
8 Plastic Head Cover
9 Steel Panel
10 Mechanism Assembly
11 Amplifier Assembly
12 Speaker and Baffle
13 Grille
14 Case
15 Interlock Plate Assembly

Figure 4. Recorder-Reproducer - Exploded View

signed to record sound on a thin plastic material coated with iron oxide, which can be magnetized. Provision is made for monitoring the signal. The recording may be reproduced immediately without further processing. Recordings can be made with a total minimum recording time of 60 minutes on each track of a 7 inch reel of tape at 3.75 inches per second or 30 minutes at 7.5 inches per second.

1.2.2 Sound recordings may be made from a microphone or from other inputs such as telephone lines, phonograph, or radio by intermittent or continuous operation. Recorded material is reproduced through a self-contained amplifier and loud-speaker. The output may be fed to an external speaker with the use of the attachment cord.

1.2.3 The equipment erases old recordings automatically as a new recording is made. It can also erase old recordings without impressing any new signal on the tape. The magnetic tape can be used repeatedly by erasing the old recording and making a new recording; it can be reproduced repeatedly in part or in whole; or it can be stored as a permanent record.

1.2.4 This equipment may be used as a public address system by connecting the microphone to the equipment and using an external speaker. Use of the internal speaker for public address purposes is not recommended because of the possibility y of acoustical feedback. It can be used however, if the microphone is placed off the loud-speaker axis and as far from it as possible.

SECTION 2

SYSTEM DESCRIPTION

2.1 GENERAL

The recorder is a self-contained unit requiring only a source of power for use. All accessories necessary for the operation of the equipment are contained in the carrying case. The mechanism and amplifier are built into the case with all operating controls readily accessible upon opening of the hinged removable cover. Space is provided within the case for storage of all accessories.

2.2 RECORDER CONSTRUCTION

The recorder consists basically of two assemblies; a mechanism assembly, and an amplifier assembly (see figure 4). The two assemblies are housed within a plywood case, together with a speaker, metal panel, and plastic covers. Suitable knobs allow convenient control of all the functions of the recorder.

2.3 STEEL PANEL AND PLASTIC COVERS

The steel panel serves as a dust cover for the mechanism assembly. In addition, the functional names of the controls and setting positions are engraved in the plastic covers for identification.

2.4 MECHANISM ASSEMBLY

2.4.1 MOUNTING

The mechanism assembly is Installed in the case directly under the steel panel with plastic covers being mounted on the steel panel. The amplifier assembly is mounted on the mechanism assembly and both must be removed from the case as a unit.

2.4.2 CONSTRUCTION

The mechanism assembly (see figures 7 through 10) consists of a system of shafts, levers, and rollers attached to the mechanism plate at suitable points to provide a mechanically interlocked train between the supply and take-up spindles. A single speed synchronous motor drives the train at the different speeds and directions determined by the setting of the pinch roller cam relative to rollers on the spring loaded levers. Interlocked with the driving mechanism are pressure and brake pad assemblies. The pressure pads press the tape against the record-reproduce-erase head as it passes the head during recording and reproducing. During FAST FORWARD and REWIND operations the pressure pads are retracted to allow the tape to pass the head with minimum drag. The brake pads apply the force required to slow down or stop the tape and reels when changing from FAST FORWARD and REWIND to FORWARD and STOP.

2.4.3 TAPE PATH

The tape is fed from the supply reel across the face of the head, between the flywheel shaft and the pinch roller, and to the take-up reel. In the STOP position the pressure pads and the pinch roller are retracted to allow easy threading of the tape.

2.5 AMPLIFIER ASSEMBLY

2.5.1 CONSTRUCTION

The amplifier chassis is attached to the mechanism plate with three screws and is removed with the mechanism assembly. The speaker leads are terminated in a plug to facilitate removal of the chassis without removing the speaker from the case.

TYPE RD-173/UN SOUND RECORDER-REPRODUCER

Designation	Function
	CONTROLS
VOLUME	Adjustment of gain during recording and of output volume during reproduction.
RECORD-LISTEN	Switching of circuit from record to reproduction.
TONE	Bass-treble tone control.
ON-OFF	Power switch for energizing equipment.
SPEAKER **CUTOUT**	Cutout switch for internal speaker.
SPEED SELECTOR	Adjustment of tape speed during recording and reproduction.
	INDICATORS
RECORD LEVEL	Visual indication of recording level as adjusted by volume control.
PILOT LIGHT	Visual indication of power application.
	CONNECTIONS
PHONO-RADIO INPUT	Receptacle for connection of phonograph or radio output to recorder.
MIC INPUT	Receptacle for connection of microphone to recorder.
EXTERNAL SPEAKER OUTPUT	Receptacle for connection of recorder output to external speaker.

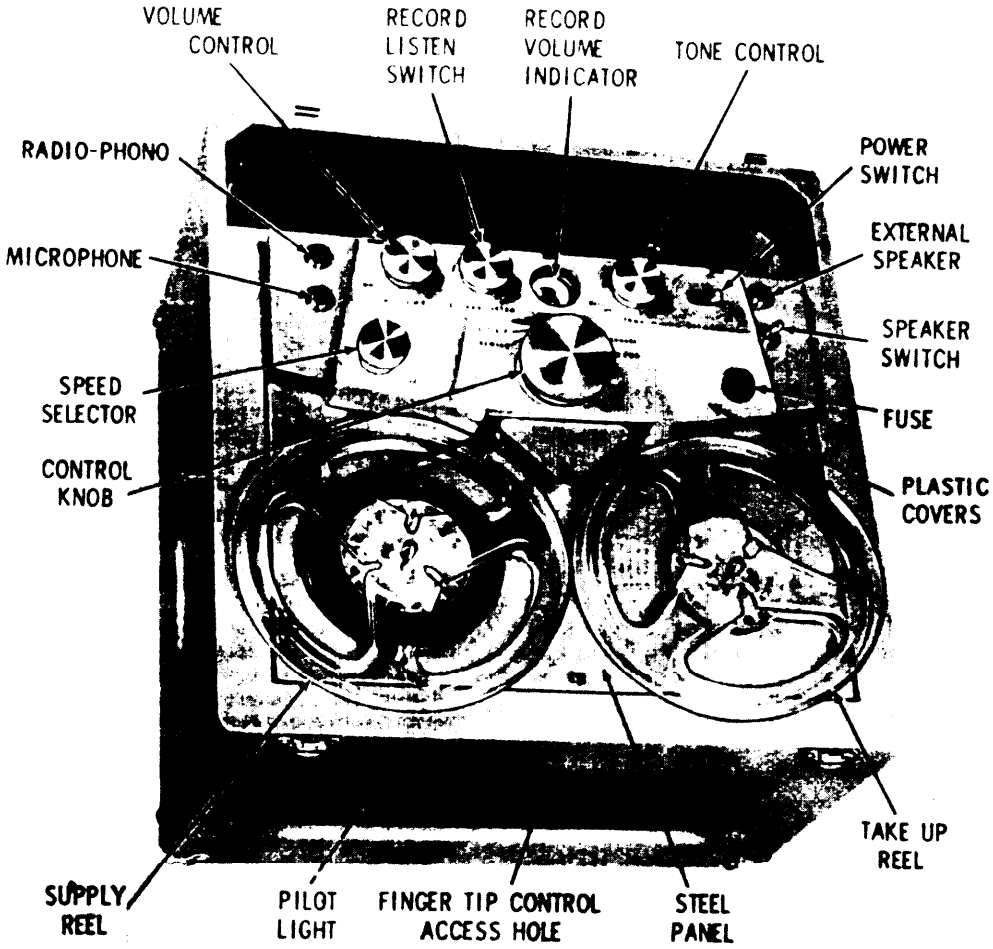


Figure 5. Panel View

2.5.2 COMPONENTS

The amplifier assembly consists of the following components:

(a) Controls, record level indicator, pilot light, and connections extending through the plastic panel (see figure 5):

(b) Line cord for input power.

(c) Two-ampere fuse.

(d) Power transformer.

(e) Rectifier tube.

(f) Three voltage amplifier tubes.

(g) Output tube.

(h) Output transformer.

(i) Bias oscillator tube.

(j) Bias oscillator transformer.

(k) Record level indicator tube.

(1) Record level indicator rectifier tube,

(m) Connections for motor, speaker, and record-reproduce -erase head.

(n) Components for B+ supply filtering, resistance coupling of amplifier stages, bias and erase oscillator and record level indicator,

SECTION 3

INSTALLATION

3.1 INSTALLATION

Installation of the recorder consists of setting the equipment on a level surface at least 16 by 19 inches with overhead clearance of 27 inches, and connecting the power cord to a convenient receptacle. There should be no equipment in the vicinity which may be propagating strong magnetic fields. Where mechanital vibrations from other equipment are prevalent, place a rubber or felt pad under the recorder to dampen the vibrations.

3.2 STORAGE

When the recorder is not in use, the cover should be closed and latched to prevent the accumulation of dust and to prevent damage to the unit from possible dropping of heavy objects on the plastic covers.

SECTION 4

ADJUSTMENTS AND TESTS

4.1 TESTS BEFORE OPERATION

The recorder should be tested prior to operation for the first time and under conditions, such as after overhaul, when it is uncertain the equipment will operate satisfactorily.

4.1.1 MECHANISM TEST

(A) Turn the control knob to STOP, connect the cable to a source of power, and turn the power Bwitch to ON.

(b) Select speed desired by turning SPEED SELECTOR.

(c) Turn the control knob to FORWARD and then to FAST FORWARD while observing the take-up shaft speed. Rotation should be clockwise.

(d) Turn the control knob slowly back through STOP to REWIND. The take-up shaft speed should decrease almost instantaneously and then stop. At REWIND, the supply shaft should rotate counterclockwise at about the same speed the take-up shaft rotated at FAST FORWARD.

4.1.2 RECORDER PERFORMANCE TEST

(a) Prepare the recorder for microphone recording as described in Section 6.

(b) Record music material of good frequency range with the recorder VOLUME control set so the record level indicator does not quite close at maximum signal. DO NOT ALLOW ANY OVERLAP.

(c) Rewind the tape, set the TONE control at TREBLE, and set the RECORD-LISTEN control at LISTEN.

(d) Rewind the tape and make a short recording of different material over part of the tape previously recorded.

(e) Play back the new material and observe whether the original material was completely erased at the time of re-recording.

(f) Rewind the tape and re-record without any new signal so the original material is erased.

(g) Play back the erased tape with the VOLUME control in the extreme clockwise position to determine that complete erasure is accomplished and that no spurious signals remain.

4.2 ADMUSTMENTS

Adjustments will be necessary only If the tests above indicate abnormal operation. Refer to Sec - tion 7.

SECTION 5

THEORY OF OPERATION

5.1 GENERAL

The following information is given to assist servicing personnel of the RD-173/UN Recorder-Reproducer in understanding the principles of magnetic recording in general, and also the theory of operation of the RD-173/UN equipment in particular.

5.2 PRINCIPLES OF MAGNETIC RECORDING

Any magnetically sensitive material such as a wire or tape of suitable steel composition or a tape or disc with suitable magnetically sensitive coating may be utiltzed for recording audio signals. Magnetically coated paper or plastic tape is used most frequently for the purpose. By means of an appropriate mechanical system the recording medium is moved through a magnetic field at a fixed rate of speed. The 'magnetic field, energized to a varying degree of magnetization through an electronic system, serves to impress the desired magnetic state upon the medium. Figure 6 shows an electromagnet in contact with a magnetic tape: Signals to be recorded are passed through the coil on the iron core, which has a minute air gap. The assembly, consisting of core and coil, is customarily called a magnetic or recording head. The dashes in the tape and in the magnet of the recording head indicate, by their direction and concentration, the magnetic condition of any part of the system. The complete disorientation to the left of the recording head exists in a demagnetized magnetic material such as an erased or unrecorded magnetic tape and corresponds to the noise level of the material. A bunching of the dashes occurs at the air gap of the magnet due to the relatively intensive magnetic field resulting in a controlled orientation of the dashes as shown to the right of the recording head.

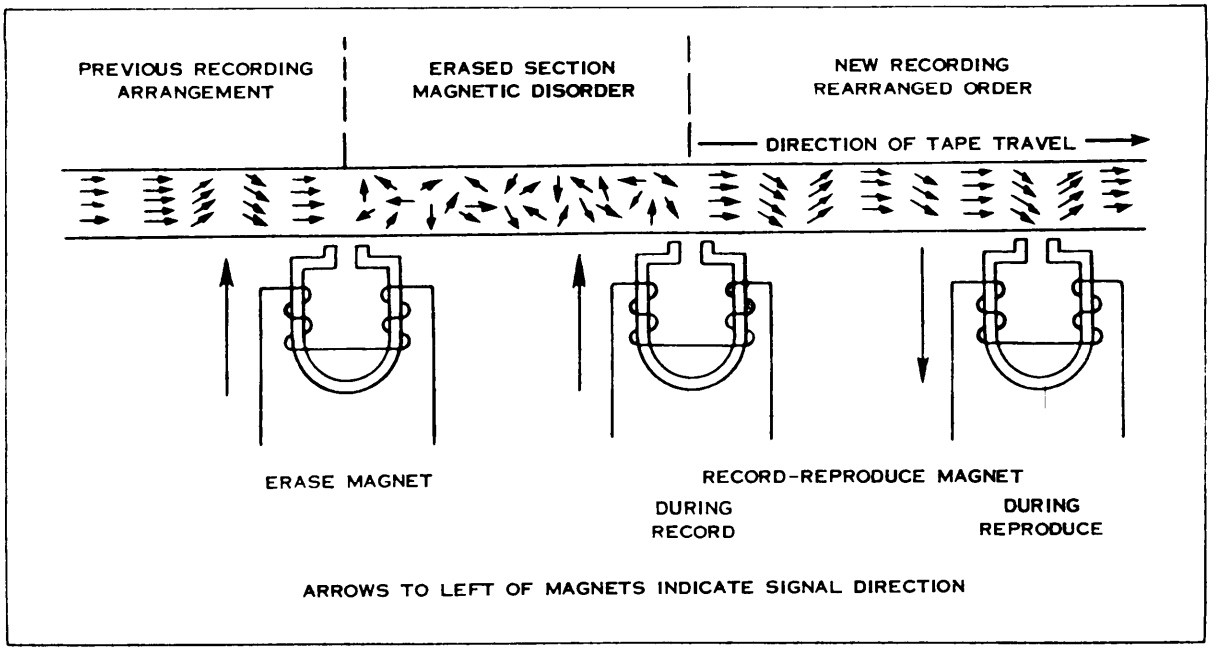


Figure 6. Principles of Magnetic Recording

The degree of orientation of the dashes is directly porportional to the amount of current flowing instantaneously in the recording head. The condition of sat uration, when all the dashes are oriented, corresponds to the maximum signal, in equivalent magnetic energy, that can be recorded and stored on the material.

For low intensities of current, the orientation tends to be temporary after the recording medium leaves the recording head, whereas the medium recorded in a strong field retains its magnetism. To obtain a stable magnetic arrangement proportional to the instantaneous level of the impressed signal it is customary to apply a high frequency signal to the recording head together with the audio signal to be recorded. This signal, called a-c bias, has a frequency high enough above the audio range to assure permanent magnetization of the recording medium without being audible during reproduction. With this bias any intensity of signal, from the lowest to complete saturation, will result in a corresponding degree of permanent magnetization of the medium.

5.3 PRINCIPLES OF MAGNETIC REPRODUCTION

The process of reproduction is similar to that of recording, using the same magnetic head (see figure 6). When the moving tape is in contact with the magnetic head at the air gap, the magnetically recorded variations on the medium create magnetic fields in the poles of the magnet. The induced magnetism in the poles of the magnet appears as voltage across the coils. This voltage is fed to the amplifier unit which increases the signal to a level suitable for the operation of a loud-speaker.

5.4 PRINCIPLES OF ERASING MAGNETIC RECORDING

The removal of an impression on a magnetic recording medium implies that the net orientation of the magnetic state is transformed into a completely neutral and disoriented condition (see Erase Magnet, figure 6). This condition is obtained by subjecting the medium to a very strong alternating current magnetic field which is designed to diminish to zero. The same result may be obtained with a constant magnetic field if the medium is moved away from the field to simulate the gradual decline in the intensity of the magnetic influence to zero. The strong magnetic field can be created by passing a current of high magnitude and high frequency through the

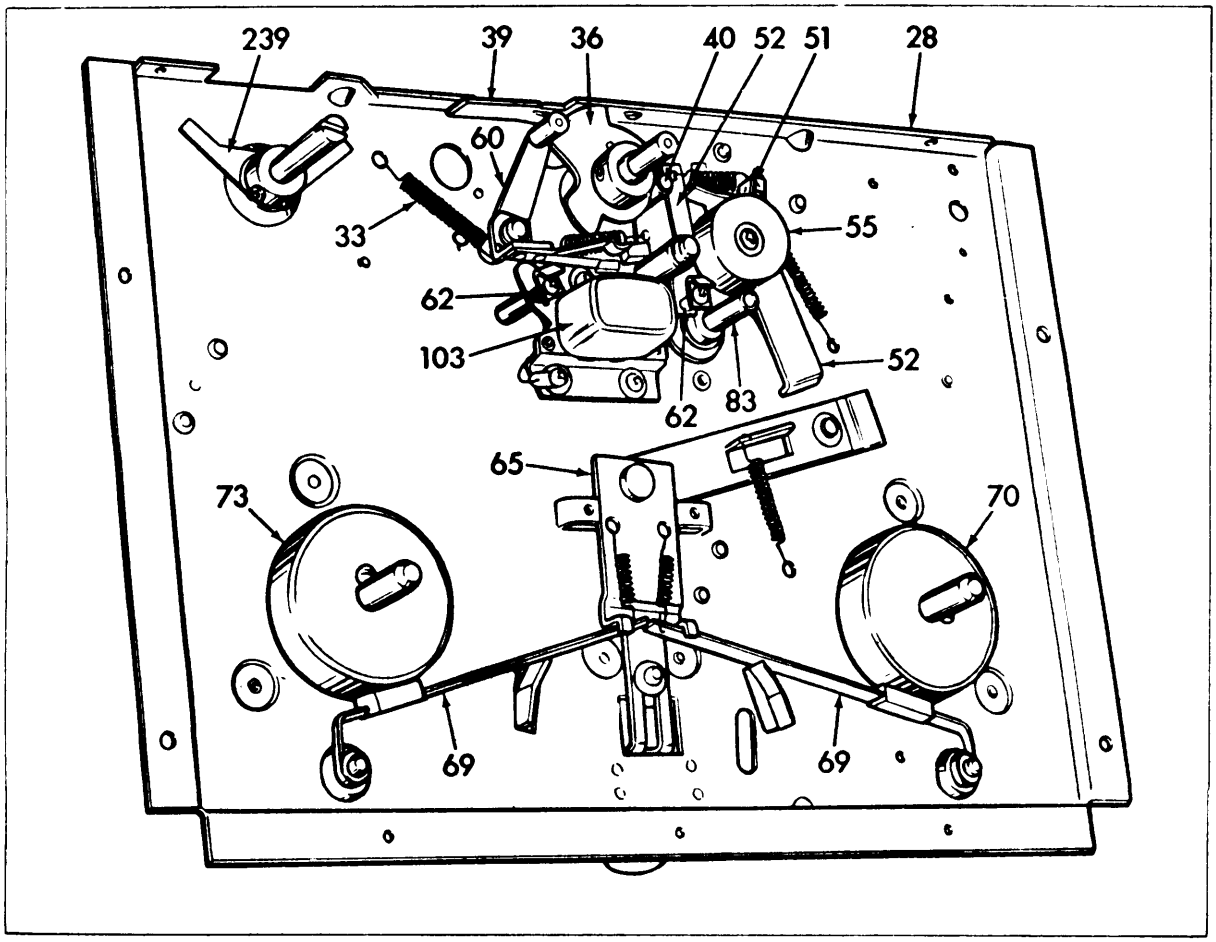


Figure 7. Mechanism Assembly - Top View

electromagnet as the tape passes through the field of the magnet. The strong magnetic field causes the magnetic state of the medium to reverse its polarity constantly and rapidly, removing in the process any previous magnetic signal impression. As a portion of the medium leaves the field of the magnet, the influence of the magnet on that portion of the medium gradually approaches zero. As a result the medium is restored to a neutral condition, its magnetic state being completely disoriented. The RD-173/UN Recorder-Reproducer is provided with a magnetic recording head which incorporates the erasing magnet. Thus, the tape is automatically erased prior to recording to prevent any double impression of sound on the same portion of the recording medium. For convenience, the same high frequency oscillator provides both the biasing current for recording and the current for erasing.

5.5 EQUALIZATION

A recorder should reproduce sounds of intelligibility and value practically equal to those which were applied during the recordng operation. However, the frequency response of the system as such is not sufficiently uniform. Therefore, the frequency response of both the record and reproduce amplifiers must be equalized to correct these deficiencies. To accomplish this the record amplifier must have a rising characteristic at the high frequencies and the reproduce amplifier must have a rising characteristlc both at the high and low frequencies. These equalizations result in a substantially uniform frequency response.

5.6 Mechanical ASSEMBLY DESIGN (See figures 7 through 10, and 24.)

5.6.1 GENERAL

The tape transport mechanism is powered by a single speed synchronous motor through a series of pulleys, idlers, take-up and supply spindles. The mode of operation is governed by the setting of the speed selector knob and the control knob which is also mechanically interconnected with the amplifier assembly in a manner which prevents accidental erasure. The following paragraphs outline the operation in each position of the speed selector and the control knob.

5.6.2 SPEED SELECTOR IN "3.75" POSITION

With the speed selector in the 3.75 position the cam shaft assembly (238) moves off the follower lever assembly (101), Spring (42) forces the idler assembly (44) to press on the smaller diameter of

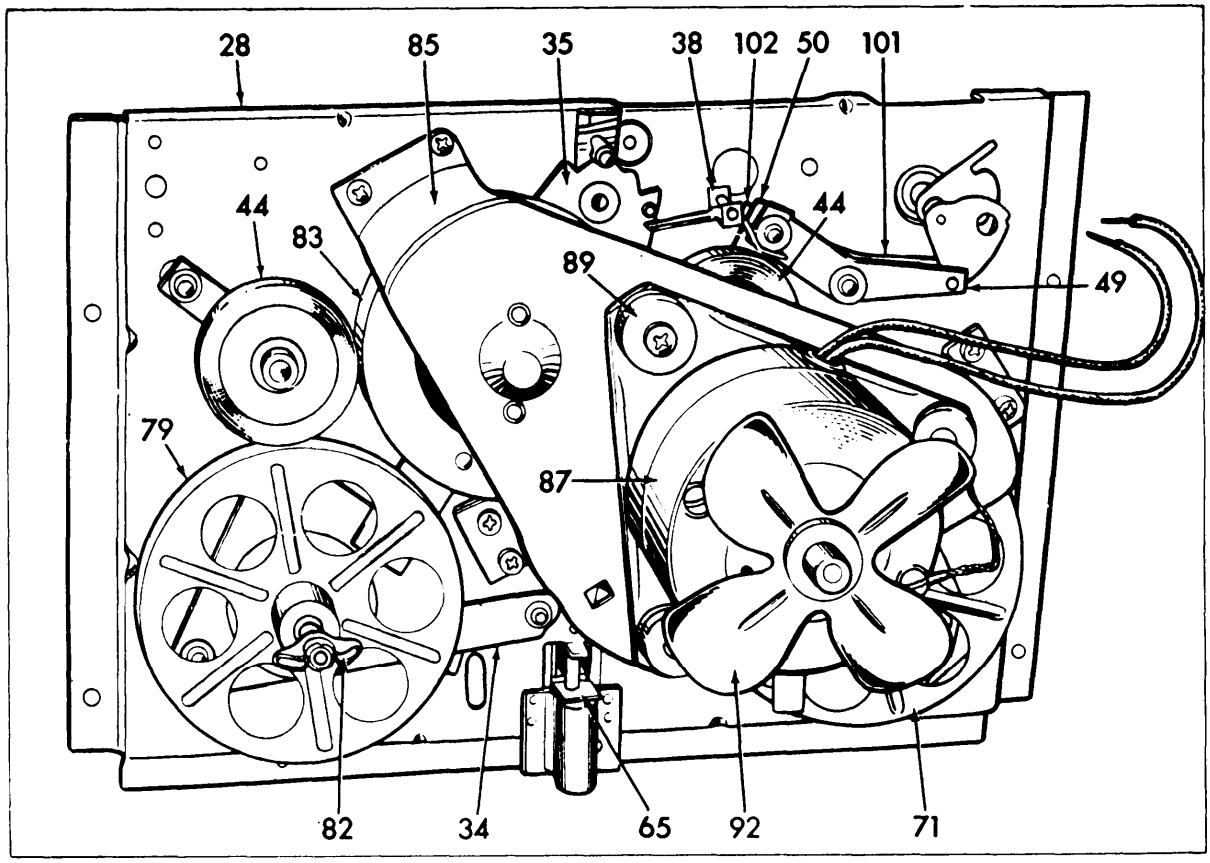


Figure 8. Mechanism Assembly - Bottom View

the motor pulley (93) and against the flywheel and shaft assembly (83) when unit is in forward position.

5.6.3 SPEED SELECTOR IN “OFF” POSITION

With the speed selector in the OFF position the cam shaft assembly (238) moves both follower lever assemblies (49 and 101) up, moving the idler assemblies (44) down and away from the motor pulley (93). When the equipment is inoperative or being stored the speed selector knob should be in the OFF position to prevent development of flat spots on the rubber drive surfaces.

5.6.4 SPEED SELECTOR IN "7.5" POSITION

With the speed selector knob in the 7.5 Position the cam shaft assembly (238) moves off the follower lever assembly (49). Spring (42) forces the idler assembly (44) to press on the larger diameter of the motor pulley (93) and against the flywheel and shaft assembly (83) when unit is in forward position.

NOTE

With the exception of the REWIND position of the control knob, the drive train is interrupted while the speed selector switch is in the OFF position.

5.6.5 CONTROL KNOB IN “STOP” POSITION

With the control knob in the STOP position the pin on the bottom side of the cam and shaft assembly (35) presses on the arm of the kickout idler lever (38), pivoting the assembly about its axis. The other two end arms of the assembly contact the pivot pins on the idler link assemblies (50 and 102) so as to move the idler assemblies away from the motor pulley (98), thereby breaking the drive train. A pin in the reel plate arm of the reel shaft support assembly (29) contacts the rounded cam surface on the cam and shaft assembly (35) to move the supply reel shaft assembly (70) away from the motor pulley (93) and against the brake lever assembly (69) to stop the supply reel. The take-up reel is stopped in a similar manner except, moving the right reel shaft support assembly (34) away from the idler assembly (44), releases the pressure on the idler between the reel pulley assembly (79) and flywheel and shaft assembly (83). At the same time the pinch roller assembly (55) is moved away from the

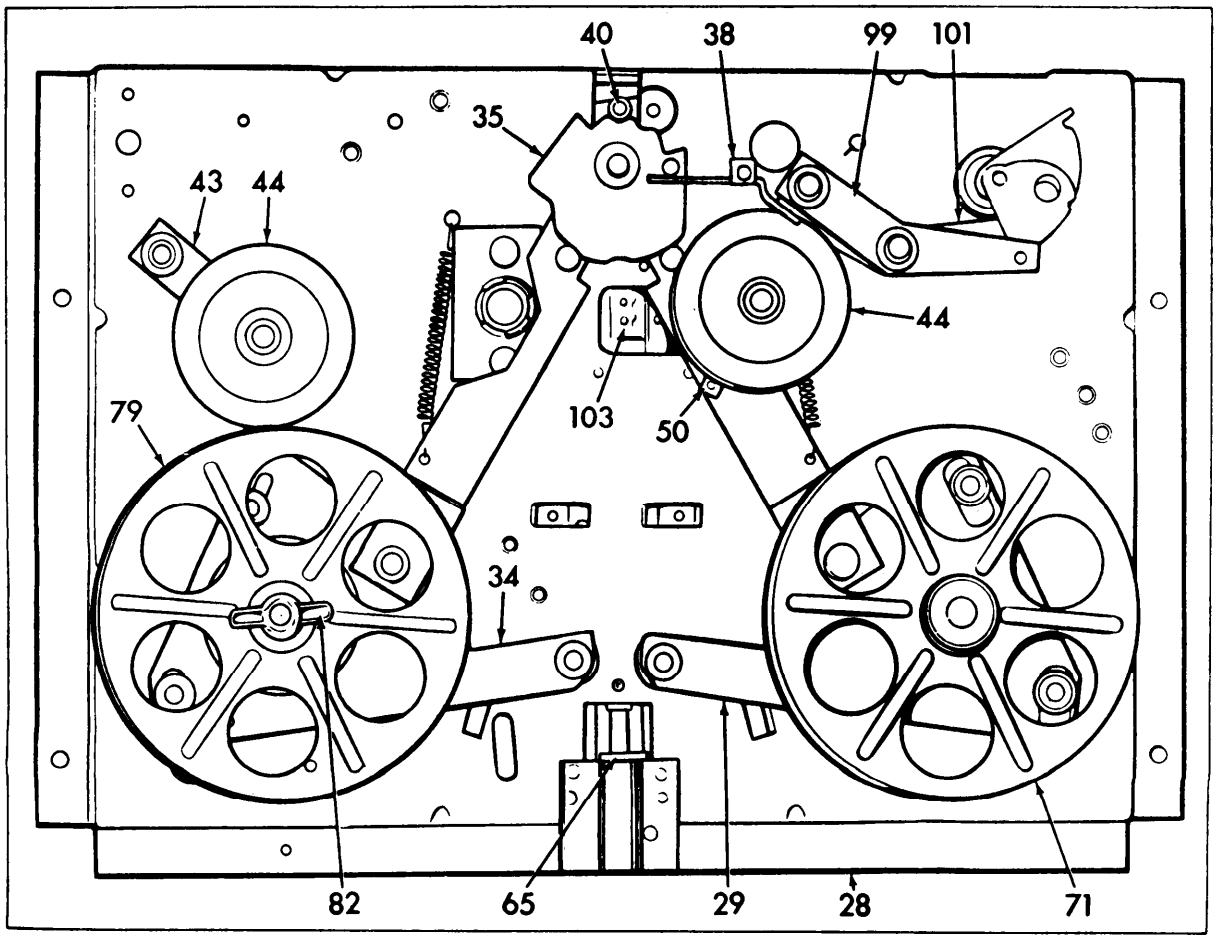


Figure 9. Mechanism Assembly without Motor and Plate Assembly - Bottom View

capstan of the flywheel and shaft assembly (83). Therefore, in the STOP position all motion except rotation of the drive motor ceases and there is no pressure on any of the rubber drive surfaces, eliminating development of flat spots.

5.6.6 CONTROL KNOB IN "FORWARD" POSITION

With the control knob in the FORWARD position the pin in the end of the arm of the pressure pad assembly (60) drops into a cutout in the cam assembly (S6) and spring (SS) attached to the assembly causes the pads to press against the tape traveling past the record-reproduce head and can assembly (103). A lobe on the cam assembly (36) causes the lever assembly (52) to pivot about its axis and press the pinch roller assembly (55) against the tape and the capstan of the flywheel and shaft assembly (83), thereby pulling the tape off the supply reel past the head. The pin attached to the reel plate arm of the right reel shaft support assembly (34) drops off the large radius surface of the control cam of the cam and shaft assembly (35) and spring (33) pulls the support assembly (34) to compress the idler assembly (44) between the reel pulley assembly (79) and flywheel and shaft assembly (83). The pulley ratios are such that the take -up reel tends to pull the tape faster than the capstan allows, but the disc clutch (’78) between the reel shaft assembly (73) and the reel pulley assembly (79) slips, and the take-up reel turns only fast enough to wind the tape at the speed allowed by the capstan. The supply reel is allowed to free-wheel with the control knob at FORWARD, but the forward lateral movement of the reel shaft support assemblies (29 and 34) when turning the knob causes the reel brake cups on the reel shaft assemblies (70 and 73) and the reel assembly (71) to contact the brake lever assemblies (69), instantly slowing down or stopping the tape reels. This braking action occurs every time the control knob is turned from one position to any other.

The roller (40) on the bottom of the index and interlock lever assembly (39) is always pulled against the control cam of the cam and shaft assembly (35) by spring (42). However, any movement of the control knob causes the lever assembly (39) to move toward the rear of the mechanism assembly, tripping the RECORD-LISTEN switch to LISTEN through the record lock arm assembly (156) in the amplifier. The control cam surface is machined in such a manner that the RECORD-LISTEN switch can only be turned to RECORD with the control knob at STOP or FORWARD. The above two conditions then pre - vent all but deliberate erasure of the tape, but still allow using the equipment for public addressing in conjunction with an external speaker and with the control knob at STOP.

5.6.7 CONTROL KNOB IN "FAST FORWARD" POSITION

With the control knob in the FAST FORWARD position, the position of the cam assembly (36) causes the pressure pad assembly (60) and the pinch roller assembly (55) to retract. The clutch in the reel pulley assembly (79) then takes over and pulls the tape at the fast speed, advancing the tape rapidly past the head, since the idler assembly (44) remains in contact with the reel pulley assembly (79) and the flywheel and shaft assembly (83).

5.6.8 CONTROL KNOB IN "REWIND" POSITION

With the control knob in the REWIND position the pin in the end of the red arm plate of the reel shaft support assembly (29) drops off the large radius cam surface of the cam and shaft assembly. Spring (33) then pulls the support assembly (29) so the reel assembly (71) contacts the clutch disc assembly (98), driving the take-up reel to rewind the tape. The pressure pad assembly (60) and the pinch roller assembly (55) remain retracted as in paragraph 5.6.7 but the right reel shaft support assembly (34) is moved laterally forward so the contact of the reel pulley assembly (79) on the idler assembly (44) is Interrupted, allowing the take-up red to free -wheel.

5.6.9 REMOTE CONTROL

A hole in the front of the case (see figure 5) allows insertion of the finger tip control rod (207) into a receptacle on the mechanism plate assembly (28). With the pin on the rod pointing up, the rod can be pushed into the receptacle. After the pin is about 1/4 inch In the receptacle, the rod can be turned counterclockwise 90°, engaging the pln in a slot in the receptacle. When the rod is pushed farther into the receptacle, the end of the rod en-

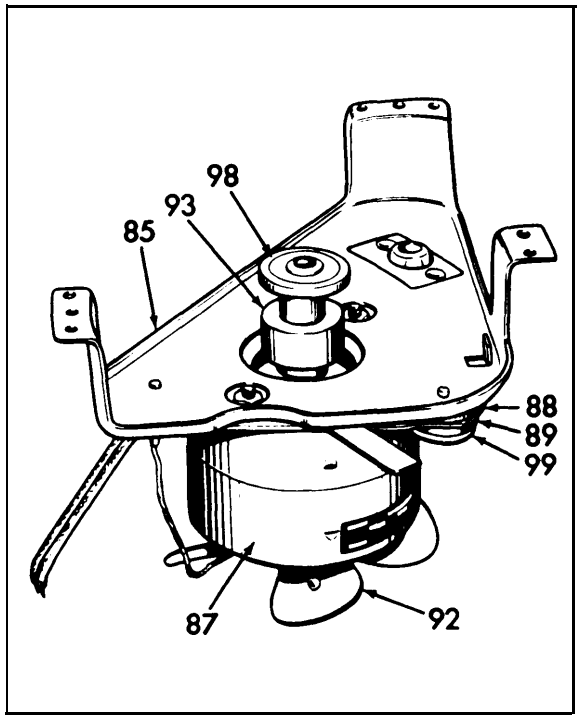


Figure 10. Motor and Plate Assembly - Top Front View

gages the remote lever assembly (65), With the control knob at FORWARD, pushing the rod to the end of its travel moves the lip on the remote stop-start lever of the lever assembly (65) to push the pinch roller lever assembly (52) so the pinch roller assembly (55) releases the tape at the capstan. In addition, the springs (68) pull the brake lever assemblies (69) so the supply and take-up reels are both stopped; the clutch on the take-up shaft slips while the drive continues to operate and the supply shaft remains ready to free-wheel. Rotation of the rod about 45° locks the equipment in the stopped position, ready to resume recording or reproduction upon release of the rod.

5.6.10 DRIVE **MECHANISM**

The motor (87) is fastened to the motor mounting plate (88) with nuts and washers (90 and 91). Shock mounts (89) are inserted in holes in the mounting plate and attached to the support plate assembly (85) with screws and washers (100 and 99), isolating motor vibrations from the remainder of the mechanism. A motor pulley (93) is attached to the motor shaft with a set screw (22). Slipped over the end of the pulley is a washer (94) and clutch disc assembly (98) driven by the pulley by means of the friction caused by the pressure of spring tension washer (96) between D washer (95) and retaining ring (97). In the event a tape binds or drags excessively while being rewound, the clutch disc assembly slips and ceases to drive the supply reel, and tearing of the tape is prevented.

5.7 AMPLIFIER ASSEMBLY DESIGN (See figures 11, 12, and 22.)

5.7.1 The amplifier assembly consists of an amplifier, power supply, input and output signal connection, connections for a magnetic record-reproduce-erase head, and drive motor and input power comections. A RECORD-LISTEN switch (S-2) provides for proper interconnection of the amplifier components for the desired mode of operation. Figures 13 and 14 illustrate the relative connections of the components in the two modes.

5.7.2 During recording, signals from the MIC or

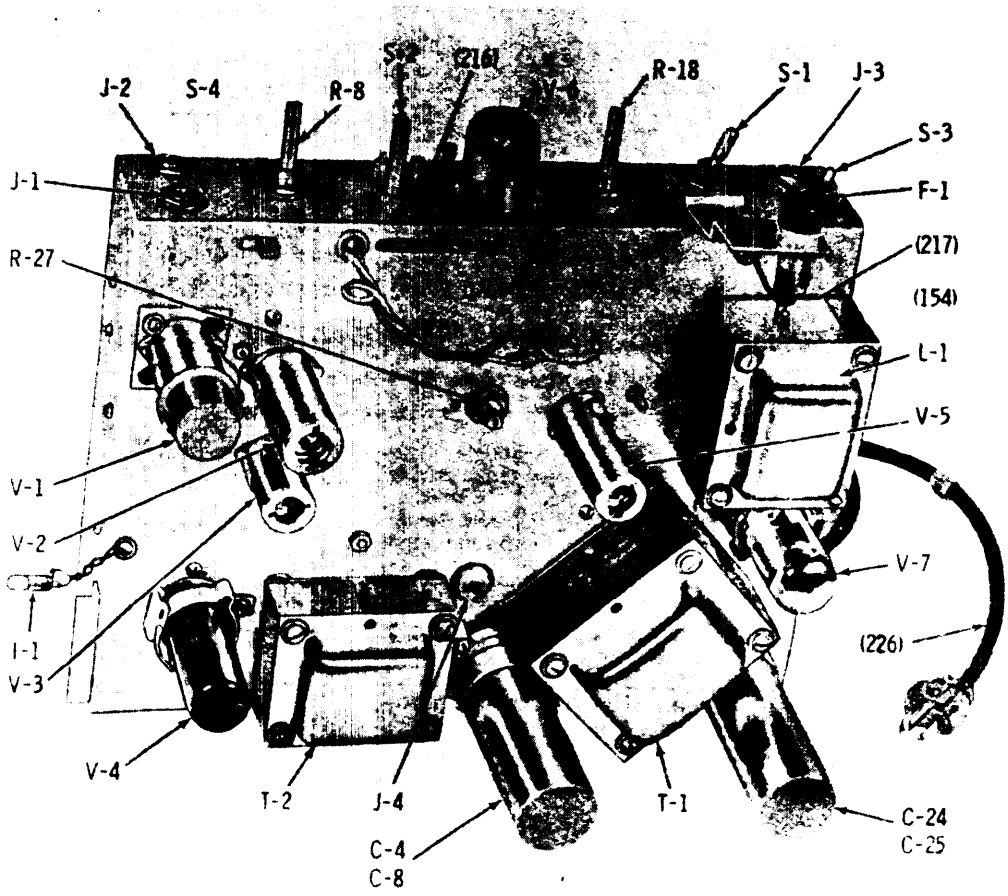


Figure 11. Amplifier Assembly - Front View

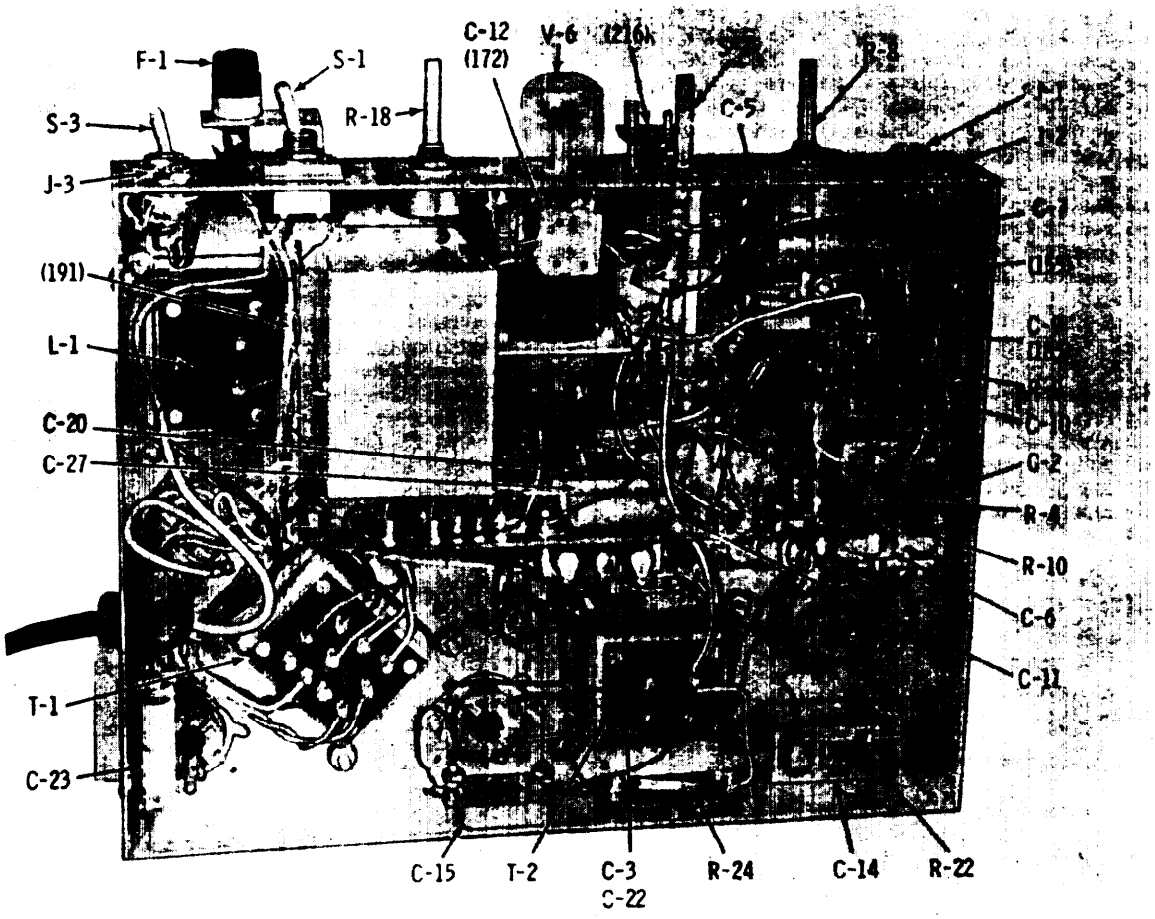


Figure 12. Amplifier Assembly - Rear View

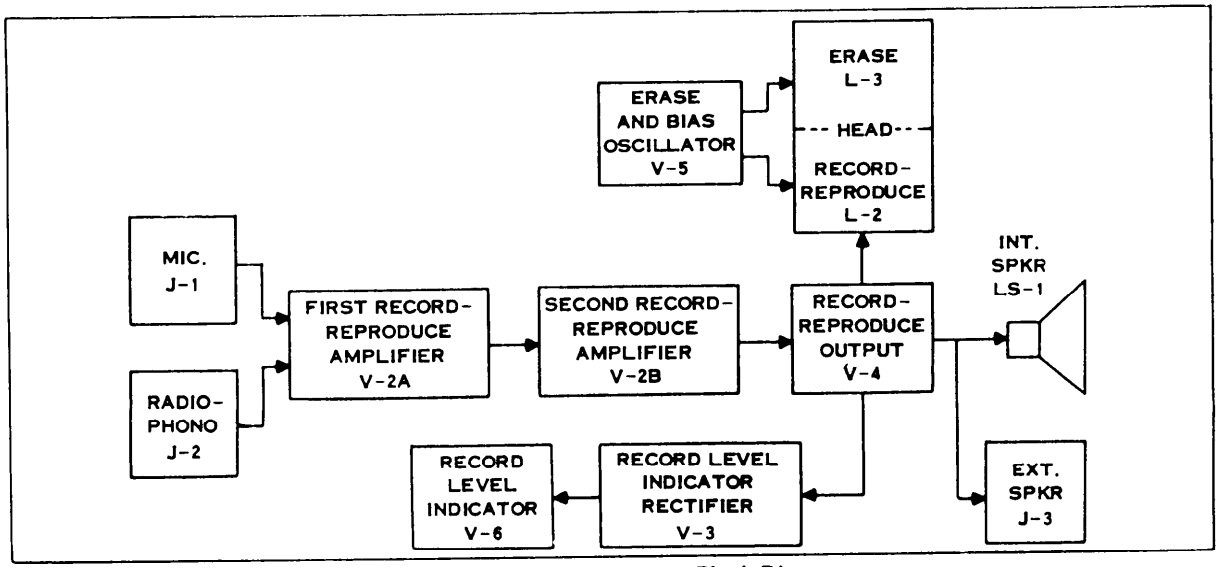


Figure 13. Record Curcuit - Block Diagram

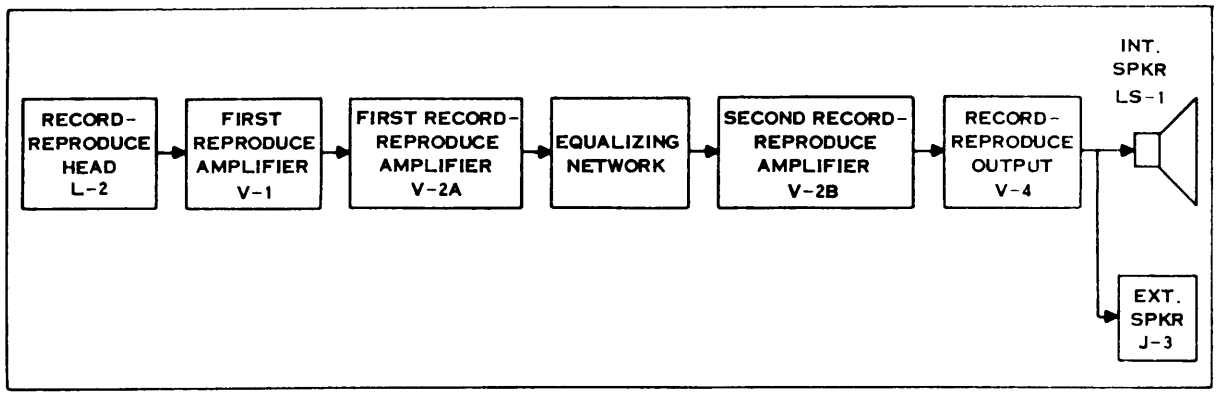


Figure 14. Reproduce Circuit - Block Diagram

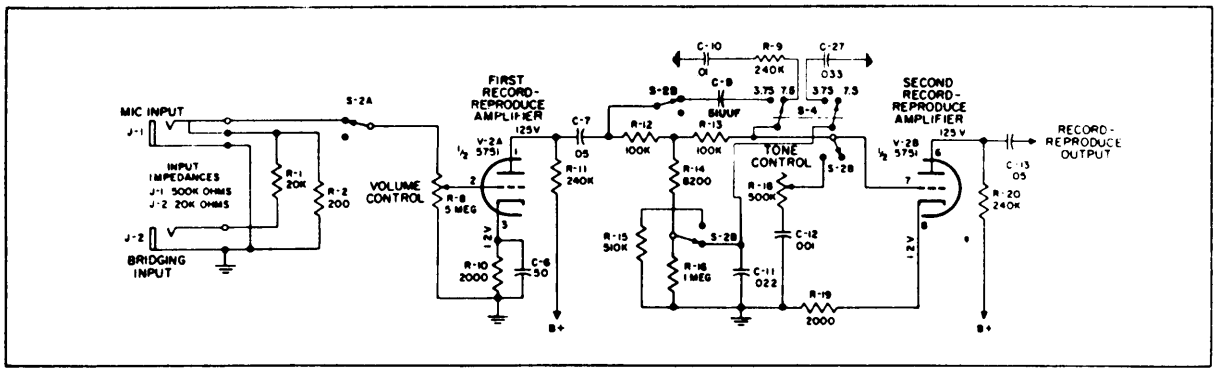


Figure 15. Input and Record Amplifiers - Schematic Diagram

RADIO-PHONO jacks (J-1 or J-2) are fed to the first and second record-reproduce amplifier stages (V-2A and V-2B) and the record-reproduce output stage (V-4), bypassing the equalizer network. Then, a part of the signal is picked up by the output transformer (T-2) for speaker operation, and the balance is fed to capacitor (C-20). Part of the amplified audio signal is rectified by the record level indicator rectifier (V-3) and fed to the record level indicator (V-6) circuit for visual indication of the signal level. The balance of the signal is impressed on the record-reproduce head (L-2) where it appears as modulated magnetism. A high frequency biasing voltage derived from the erase and bias oscillator (V-5) is fed along with the signal from the record-reproduce output stage (V-4) to the record-reproduce head, providing a-c bias to assure permanent magnetization of the recording medium. The oscillator also is used to create the magnetic field in the erase head (L-3) in order to erase any previous signal on the tape prior to recording.

5.7.3 During reproduction, the signal on the tape passing the record-reproduce head (L-2) induces a voltage in the head proportional to the magnetic state of the tape. The voltage is impressed on the grid of the first reproduce amplifier tube (V-1) for preliminary amplification. The signal then passes to the output through the other stages and equalizer network.

5.8 CIRCUIT ANALYSIS

5.8.1 INPUT POWER AND MOTOR (See figure 22.)

Power of the recommended voltage and frequency is connected to the equipment through the line cord furnished. A toggle switch (S-1) turns the power on and off to the equipment and the fuse (F-1) protects the unit against overload. The power transformer (T-1) and the drive motor are paralleled across the line so that, upon turning the TONE CONTROL from OFF, the equipment is energized. High voltage for the B+ supply through the rectifier (V-7), filament voltage for the rectifier, and filament and pilot light power are all provided by the power transformer (T-l). The pilot light (I-1) is concealed behind the speaker grill (see figure 5) and becomes visible only when the power is on. Capacitors (C-24 and C-25) and choke (L-1) form the primary B+ filter circuit, with capacitors (C-4 and C-7) and resistors (R-7 and R-17) Providing additional filtering for the first two stages. Capacitors (C-21, C-23 and C-26) are included to keep r-f energy from feeding back to the power supply.

The center tap of the filament winding of power transformer (T-1) is returned to a positive voltage (14.5 V) at the cathode (pin 8) of the record-reproduce output tube (V-4) in order to reduce the filament hum of the amplifier.

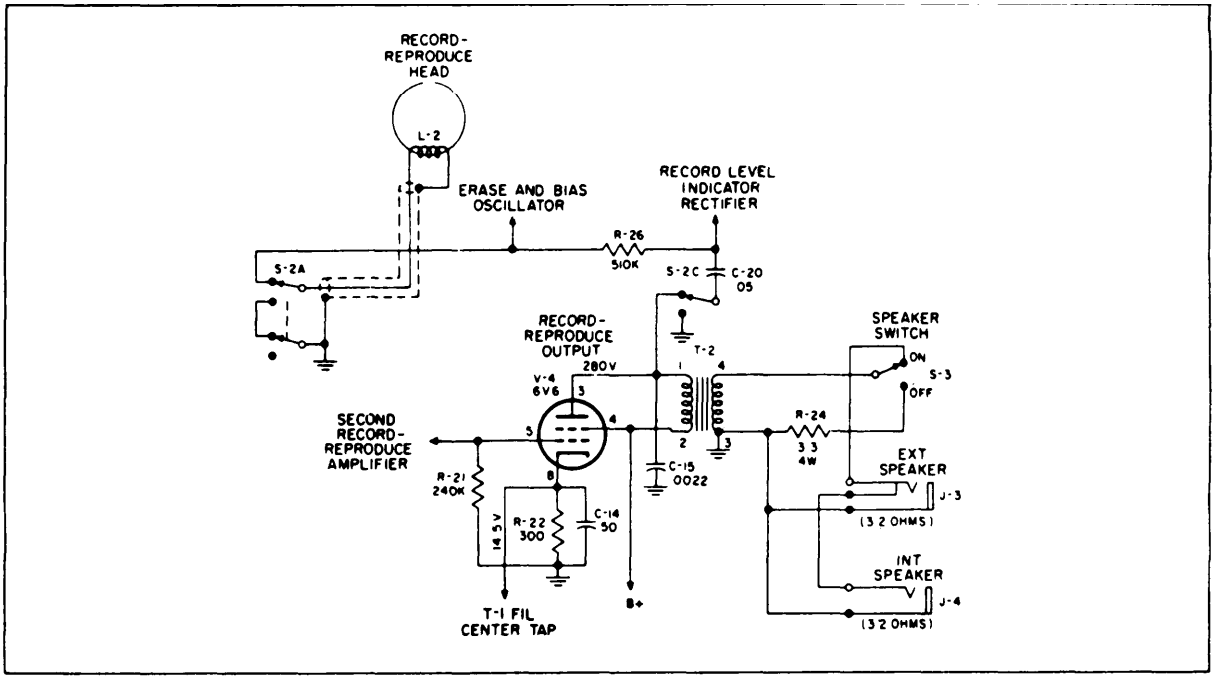


Figure 16. Output and Record Head - Schematic Diagram

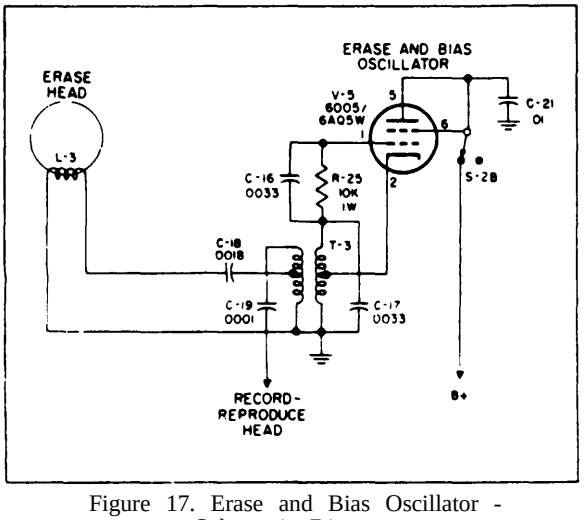


Figure 17. Erase and Bias Oscillator - Schematic Diagram

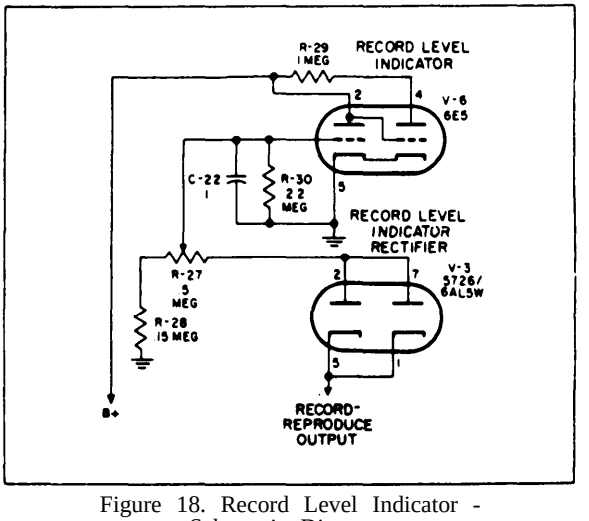


Figure 18. Record Level Indicator - Schematic Diagrams

5.8.2 RECORDING

5.8.2.1 INPUT AND AMPLIFIERS (See figure 15.)

The input signals from the RADIO-PHONO or MIC jacks (J-1 and J-2) are impressed on the grid of the first record-reproduce amplifier tube (V-2A) as a voltage above ground determined by the VOLUME control (R-8) setting. Resistors (R-1 and R-2) form a voltage divider network which limits the voltage to the grid from the RADIO-PHONO jack. The amplified signal from V-2A appearing across plate resistor (R-n) is fed through coupling capacitor (C-7) and resistors (R-12 and R-13) to the grid (pin 7) of V-2B, the second record-reproduce amplifier. Resistors (R-14, R-15, and R-16) provide a bias network for this stage and R-19 is the cathode resistor. The amplified 'signal from V-2B appears as a voltage across R-20 at coupling capacitor (C-13).

5.8.2.2 OUTPUT AND RECORD HEAD (See figure 16.)

The output from the second record-reproduce amplifier is impressed on the grid (pin 5) of the record-reproduce output tube (V-4). The voltage

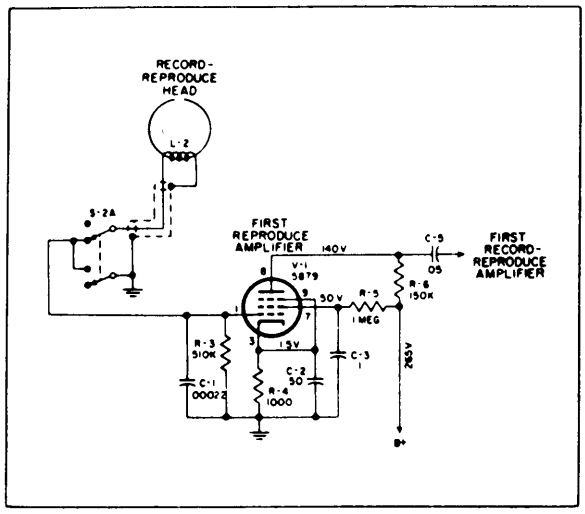


Figure 19. Reproduce Head and First Reproduce Amplifier - Schematic Diagram

generated across the primary of the output transformer (T-2) is fed through coupling capacitor (C-20) and resistor (R-26) to the record-reproduce head (L-2) where the signal is impressed on the recording medium as modulated magnetism. A 35 kc signal from an erase and bias oscillator is mixed with the amplifier audio signal at R-26 to provide the required recording bias. A part of the signal is picked off between C-20 and R-26 for operation of the record level indicator. The voltage across the primary of output transformer (T-2) also generates a voltage in the secondary which is fed to the internal and external speaker jacks (J-3 and J-4) through the speaker switch (S-3). With an external speaker connected, the internal speaker is automatically disconnected. Resistor (R-24) in series with the speaker switch OFF terminal provides a load for the amplifier when the speaker is cut out by the switch. Capacitor (C-15) between the output transformer primary and ground eliminates spurious frequencies above the audible range which may be present due to stray circuit resonances.

5.8.2.3 ERASE AND BIAS OSCILLATOR (See figure 17.)

The high frequency energy for recording bias and for erasing is derived from a series fed Hartley oscillator circuit. The resonant frequency of the circuit, T-1 winding with C-17, determines the frequency of oscillation. The plate (pin 5) of the erase and bias oscillator tube (V-5) is connected (through the B+ supply) to the grounded end of T-1 and the grid is connected to the other end through R-25 and C-16. The cathode is connected in between, thus dividing the coil into two sect ions. Any initial disturbance sets up a voltage in the grounded end of the coil which sets up an oscillating voltage in the whole coil and condenser (C-17) circuit; part of the voltage is applied between the cathode and grid to keep the circuit oscillating. A network (R-25 with C-16) provides the grid bias for the oscillator. Capacitor (C-21) is included in the B+ supply to prevent passage of r-f energy back to the supply. The other coil of T-3 serves as the output coupling of the oscillator to the record-reproduce -erase head (L-2 and L-3).

5.8.2.4 RECORD LEVEL INDICATOR (See figure 18.)

The signal from the record-reproduce output is fed to the half wave record level indicator rectifier (V-3). This rectified voltage is fed through part of level adjusting resistor (R-27) to the grid of the record level indicator (V-6). The rectified voltage varies with the signal being recorded and provides bias which causes a visual indication of the recording level on the screen of the record level indicator. R-29 is the plate load resistor for V-6. Resistors (R-27, R-28, and R-30), together with capacitor (C-22), provide a time constant such that the image on the screen opens and closes slowly enough for the human eye to follow.

5.8.3 REPRODUCING

5.8.3.1 REPRODUCE HEAD AND FIRST REPRODUCE AMPLIFIER (See figure 19.)

The magnetized particles on a tape passing the

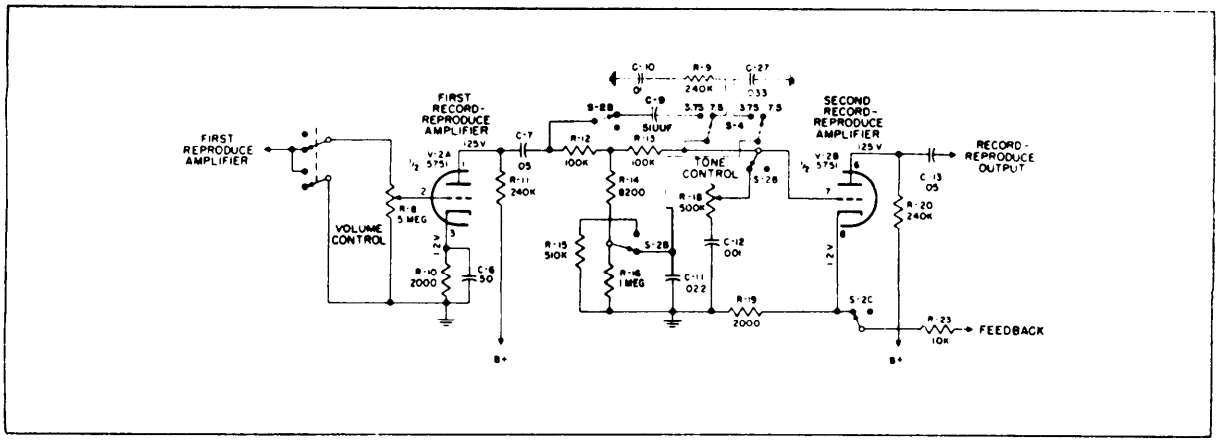


Figure 20. Amplifiers and Equalizing Network - Schematic Diagram

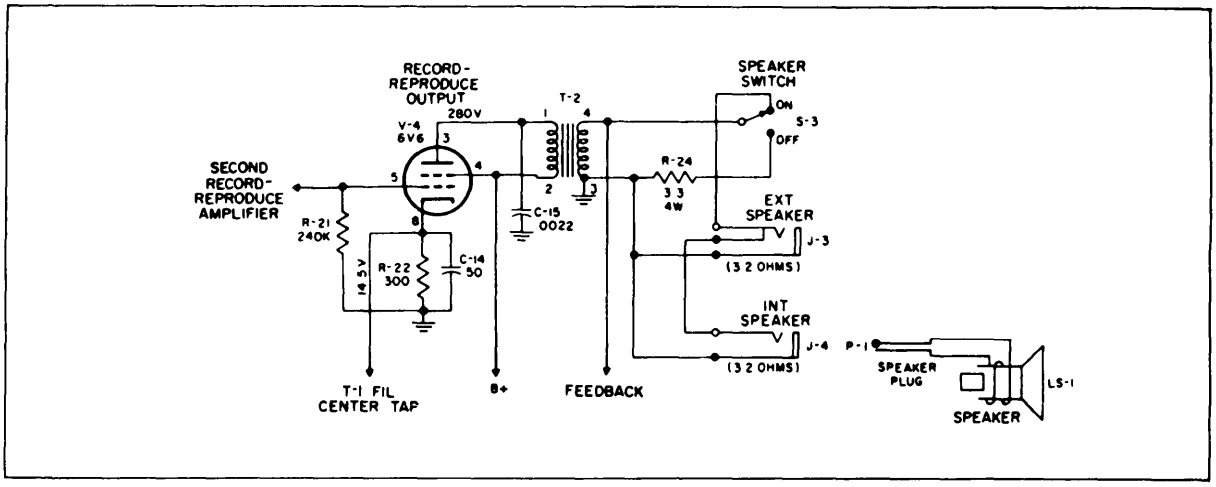


Figure 21. Reproduce Output - Schematic Diagram

record-reproduce head (L-2) induce a modulated signal in the head. This signal is fed to the grid (pin 1) of the first reproduce amplifier tube (V-1) and amplified, appearing as a voltage across plate load resistor (R-6) at coupling capacitor (C-5). Capacitor (C-1) in series with the inductance of the head winding (L-2) form a resonant circuit to boost the high frequency response.

5.8.3.2 AMPLIFIERS AND EQUALIZING NETWORK (See figure 20.)

The signal from the first reproduce amplifier is fed through capacitor (C-5) to the volume control (R-8) and to the grid (pin 1) of the first record-reproduce amplifier (V-2A). The amplifier signal, appearing as a voltage across plate load resistor (R-n) is fed through coupling capacitor (C-7) to a bass-treble compensating network. R-12, R-13, R-14, R-16, C-11 and C-27 form a voltage divider-bass compensating network in the 3.75 position of S-4 to overcome the lack of bass which is characteristic of tape recording, and capacitor (C-9) provides high frequency pre-emphasis to overcome the characteristic high frequency droop.

In the 7.5 position of S-4 however, C-27 and C-9 are switched out of the circuit. R-9 and C-10 are switched into the bass compensating network to overcome the effects of the increased tape speed. R-18 and C-12 form a tone control which attenuates the high frequencies approximately linearly with rotation of tone control (R-18). The signal then is impressed on the grid (pin 1) of the second record-reproduce amplifier (V-2B) where it appears as a voltage across plate load resistor (R-20) at capacitor (C -13). in order to reduce distortion to a minimum, a feedback loop through resistor (R-23) is introduced at the cathode (pin 2) of V-2B from the secondary of the output transformer.

5.8.3.3 REPRODUCE OUTPUT (See figure 21.)

The signal from the second record-reproduce amplifier (V-2B) is fed to the grid (pin 5) of the record-reproduce output tube (V-4), from which it is fed to the primary of the output transformer (T-2). The signal on the primary induces a voltage in the secondary which is fed to the internal speaker through the speaker switch (S-3), the contacts of the external speaker jack (J-3), and to the internal speaker jack (J-4) and plug (P-1) to the speaker (LS-1). Connecting an external speaker to J-3 automatically cuts out the internal speaker by opening the normally closed contact in the jack. To cut out the speaker, the speaker switch (S-3) is turned off, connecting load resistor (R-24) across the output.

SECTION 6

OPERATING INSTRUCTIONS

CAUTION

It is mandatory that the equipment be secured with the control knob at STOP to prevent seriously denting the rubber drive surfaces. In addition, the knob must be turned to STOP whenever the power switch is turned to OFF, if even for only a short time.

6.1 SET-UP PROCEDURE

6.1.1 Install the recorder as outlined in Section 3. Be sure the power supplied is of the proper voltage and frequency.

6.1.2 With the control knob at STOP, turn the power switch to ON. (See figure 5.) Allow about 30 seconds for the tubes to warm up.

6.1.3 Place an empty reel on the take-up spindle and a reel with tape on the supply spindle. Allowing sufficient slack, drop the tape in the space between the plastic head cover and the plastic cover, with the dull side of the tape toward the head. Slip the end of the tape into one of the slots in the empty reel and turn the reel clockwise by hand until all the slack is out of the tape. Set speed selector to desired speed.

6.2 RECORDING

6.2.1 MICROPHONE RECORDING

6.2.1.1 Throw the SPEAKER CUTOUT switch to OFF and turn the VOLUME control to about the middle of its range. Connect the microphone cable to the MIC INPUT jack.

6.2.1.2 Press the interlock button adjacent to the RECORD-LISTEN switch and at the same time turn the RECORD-LISTEN switch to RECORD.

6.2.1.3 Adjust the VOLUME control to the position where the record level indicator does not quite overlap at the peak input signals.

6.2.1.4 Turn the control knob to FORWARD and repeat the procedure of paragraph 6.2.1.2 to monitor the input, throw the SPEAKER CUTOUT switch to ON and follow procedure of paragraph 6.5.

6.2.1.5 Turn the control knob to STOP or REWIND as desired to terminate recording. The RECORD-LISTEN switch automatically returns to LISTEN whenever the position of the knob Is changed, thereby preventing inadvertent erasure of recorded material.

6.2.2 RADIO RECORDING

6.2.2.1 Tune the radio for best possible reproduction and adjust the radio volume control to normal output volume.

6.2.2.2 Adjust the recorder as outlined m paragraph 6.2.1.1, but connect the speaker cable to the RADIO-PHONO INPUT jack and attach the two clips of the cable to the radio speaker terminals.

6.2.2.3 Record the signal as outlined in paragraphs 6.2.1.2 through 6.2.1.4.

6.2.3 PHONOGRAPH RECORDING

6.2.3.1 Place the desired record on the phonograph and adjust the phonograph volume control to normal output level.

6.2.3.2 Connect the phonograph speaker and record per paragraph 6.2.2.

6.2.4 DOUBLE TRACK RECORDING

6.2.4.1 The equipment is designed to record a track on slightly less than one half the width of the tape at one time and it is possible to reverse the tape to record on the other half, thereby doubling the use of each tape.

6.2.4.2 When all but the last few feet of a tape has been recorded on one track, or at any desired earlier point, stop the equipment and remove both reels. Turn the reel from the take-up spindle upside down (also the other if not empty) and install each reel on the spindle opposite from the one from which it was removed. Thread the tape past the head per paragraph 6.1.3 and continue recording per paragraph 6.2.

NOTE

Editing is not possible on double-track recorded tape.

6.3 REPRODUCING

6.3.1 Either place a recorded reel of tape and an

empty reel on the recorder and thread per paragraph 6.1.3, or rewind the tape which has just been recorded by turning the control knob to REWIND.

6.3.2 In case of REWIND, stop the tape when the take-up reel is almost empty or at any other desired position by turning the control knob to STOP, and allow the tape to come to a complete stop.

6.3.3 In case a recorded reel is placed on the recorder, turn the control knob to FAST FORWARD until the desired portion of the tape is reached.

CAUTION

Be sure the RECORD-LISTEN switch is turned to LISTEN at any other time than when actually recording to prevent inadvertent erasure of desired material.

6.3.4 Turn the control knob to FORWARD and set the VOLUME and TONE controls for the desired level and treble de-emphasis.

6.4 PUBLIC ADDRESS SYSTEM

6.4.1 An external speaker can be used in conjunction with the recorder to provide music and voice for public address purposes.

6.4.2 Connect the microphone per paragraph 6.2.1, thread any desired tape with music or other material on the recorder per paragraph 6.1.3, and connect an external speaker to the EXT SPKR OUTPUT jack using the speaker cable furnished with the equipment.

6.4.3 To switch from the tape to the microphone proceed as follows:

(a) Turn control knob to STOP.

(b) Set RECORD-LISTEN switch at RECORD.

(c) Adjust VOLUME control to desired level. (See paragraph 10, General Data, for feedback prevention.)

6.4.4 To switch from the microphone to the tape proceed as follows:

(a) Turn control knob to FORWARD.

(b) Adjust VOLUME and TONE controls to desired level and de-emphasis.

6.5 MONITORING

Monitoring of material being recorded is accomplished by listening to the output at either the internal or an external speaker. Connecting an external speaker automatically cuts out the internal speaker. Take all precautions to prevent acoustical feedback (see paragraph 10, General Data). If conditions make it impossible to eliminate feedback, monitoring is not possible and the speaker switch must be turned to OFF. Monitoring may be accomplished by means of a headset if desired. Connect the headset to the EXT SPKR OUTPUT.

6.6 ERASING

Erasure is accomplished automatically as new material is recorded on a tape previously used. To erase all material without re-recording, turn the VOLUME control full y counterclockwise and, without any input, turn the control knob to FORWARD and the RECORD-LISTEN switch to RECORD.

6.7 SPLICING AND EDITING

Unwanted portions of a recording may be removed, broken tape may be repaired, and various different tapes can be joined by splicing. Cut out unwanted portions or trim broken ends straight across the tape. Overlap the new ends about one inch and cut diagonally through both pieces. Butt the diagonally cut ends and apply splicing tape to the glossy side of the tape (Minnesota Mining and Manufacturing Co, No. 41; if unavailable, use any pressure sensitive cellulose tape, but only in an emergency since extrusion of the adhesive may cause later difficulties). Trim the edges so the tape is slightly narrower at the splice to prevent any interference in the recording head tape slot.

NOTE

Editing is not possible when both tracks have been recorded since portions of one track cannot be removed without affecting the other.

6.8 REMOTE STOP-START

6.8.1 For editing material while recording, the finger tip control rod furnished provides a convenient method of instantaneously starting and stopping the tape without touching the main controls.

6.8.2 Insert the knob into the socket opening on the front of the case with the locking pin vertical. When the pin is about 1/4 inch inside the opening, turn the knob 1/4 turn counterclockwise to prevent its falling out .

6.8.3 When it is desired that the tape be stopped, push the knob in to the Iimit of its travel and turn 1/8 turn clockwise.

6.8.4 When starting is desired, turn the knob 1/8 turn counterclockwise and release.

6.9 LOGGING

Logging scales are located on the panel at the take-up shaft to indicate nominal elapsed time, and at the supply shaft to indicate the remaining time with respect to a full reel of tape.

SECTION 7

MAINTENANCE

7.1 PREVENTIVE MAINTENANCE

7.1.1 TAPE

Keep blank and recorded tape away from extremes of temperature and humidity and from magnetic fields, preferably in separate steel humidors similar to film cans. Handle tape carefully when unwinding from reels to prevent damage and accumulation of dirt.

7.1.2 RECORDER

Always turn the control knob to STOP, SPEED SELECTOR to OFF and the ON-OFF switch to OFF when not in use. Be sure the power supply is 115 V, 60 cps. Store accessories in the case and close the cover when not in use to prevent the accumulation of dirt in the equipment. Remove dust with a soft brush prior to use.

7.1.3 ROUTINE MAINTENANCE CHART

The following chart lists the items to be checked to obtain optimum performance and life of the equip ment.

(a) Prior to intermittent use or daily in continuous use.

Test Before Operation See paragraph 4.1.

(b) After 200 hours operation or when inoperative for one year or more.

Lubrication	See paragraph 7.1.4
Head Face Flywheel Capstan Pinch Roller Tape Guide Spacers	Clean with soft cloth dampened with chemically pure carbon tetrachloride.
Pressure Pads	Soak in chemically pure carbon tetrachloride to remove dirt, and dry, or replace if hard.
Internal Speaker	Remove dust with soft brush. Connect to signal generator and if cone rattles or is torn, replace.
General	Visually inspect for: (a) Dirt or foreign matter (b) Corroded connections and parts (c) Deterioration of wiring or parts (d) Loose connections or parts (e) Flat spots on rubber covered wheels

7.1.4 LUBRICATION

(a) Sintered bronze (oilite) bearings are prelubricated for the life of the bearing. When assembled to the mechanism plate, the bearings are saturated with oil and will require no further lubrication.

CAUTION

Any excess oil will find its way onto the rubber drive and cause unsatisfactory operation of the mechanism. Grease shall be applied sparingly. Only a thin film of grease is required in all cases. Remove dirty and excessive grease with carbon tetrachlorlde before relubrication. Never use cleaning sol - vent on oilite bearings. Clean by wiping with a clean dry cloth.

(b) Lubricate cams, levers and sliding parts with Liqui-Moly NV grease or equivalent.

7.2 CORRECTIVE MAINTENANCE

7.2.1 TROUBLE CHART

TROUBLE	CAUSE	REMEDY
1. Motor and amplifier inoperative with switch ON.	Blown fuse.	Replace fuse.
	Power supply defect.	Check for correct voltages as shown on figure 22.
	Damaged *or worn* power cord assembly.	Repair or replace.
	Broken OFF-ON switch.	Replace switch.
2. Sound is fuzzy, faint, distorted, or no sound.	Dirty head.	Clean head. Do not remove or change position of head.
	Over-recorded or under-recorded tape.	See paragraph 6.2.
	Amplifier trouble.	Check amplifier, paragraph 7.2.2.2.2.
	Pressure pads not functioning.	Check action of pressure pad lever, paragraph 7.2.2.2.3.
	Worn or dirty pressure pad.	Replace or clean pressure pad lever assembly. Paragraph 7.1.3b.
	Record head not operating.	Check oscillator bias voltage to record head, paragraph 7.2.2.3.
3. No sound, but motor operates and tubes light.	Amplifier trouble.	Check amplifier, paragraph 7.2.2.3.
	Open circuit to speaker.	Check continuity through plug to speaker.
4. Erasing incomplete or no erase.	Dirt on face of head.	Clean head, paragraph 7.1.3b.
	Oscillator not operating.	Check erase voltage with an a-c vacuum tube voltmeter. Should be approximately 45 volts.
	Damaged erase coil in head.	Check erase head continuity.
	Pressure pads worn, damaged, or out of adjustment.	Adjust or replace, paragraph 7.2.2.2.4.
5. Does not record.	Faulty microphone or cord.	Replace.
	Defective input jack.	Check and replace defective component.
	Defective tube in amplifier or output stage.	Check tubes and replace.
	Insufficient bias voltage.	Check bias voltage across head with a-c vacuum tube voltmeter. Should be about 100 V.

TROUBLE CHART (CONT)

TROUBLE	CAUSE	REMEDY
5. Does not record (Cont)	Dirt on face of head.	Clean head, paragraph 7.1.3b.
	Pressure pads worn, damaged, or out of adjustment.	Adjust or replace, paragraph 7.2.2.2.4.
	Record coil open.	Replace head unit, paragraph 7.2.3.8.
6. Does not reproduce. Sound of amplifier only.	Open coil in head.	Replace head unit, paragraph 7.2.3.3.
	Open input circuit.	Check circuit, paragraph 7.2.2.3.
7. Howl or ringing sound.	Microphonic tube.	Replace bad tube.
8. Poor high frequency response.	Defective capacitors C-10, C-11, C-12, C-27 or resistors R-14, R-16, R-18.	Replace.
	Defective contacts on switch S-2B or S-4.	Replace switch.
	Defective resistor R-23 or switch S-2C, or break in feedback loop.	Repair or replace.
	Dirty head.	Clean.
	Pressure pads worn, damaged, or out of adjustment.	Adjust or replace, paragraph 7.2.2.2.4.
9. Loud hum on reproduce.	Defective switch S-1.	Replace.
10. Recording unintelligible on playback.	Improper record bias.	Check bias oscillator circuit parts and replace.
	Dirty head.	Clean.
	Pressure pads worn, damaged, or out of adjustment.	Adjust or replace.
	Defective component in reproduce amplifier circuit V-1.	Check and replace defective component
11. Distorted bass response.	Defective part in equalizing network.	Replace defective part.
	Magnetized or defective record head.	Demagnetize or replace.
12. Muffled or low output.	Leaky or shorted coupling capacitor.	Replace.
	Dirty head.	Clean.
	Weak amplifier tube.	Replace.
	Defective microphone.	Replace.
13. REWIND inoperative, noisy or irregular.	Damaged or worn motor pulley assembly.	Replace.
	Supply reel shaft support assembly, dirty or damaged.	Clean, lubricate or replace.
	Supply reel support spring is broken.	Replace.

TROUBLE CHART (CONT)

TROUBLE	CAUSE	REMEDY
14. REWIND slow or inoperative.	Brake dragging on take-up reel.	Adjust brakes, paragraph 7.2.2.2.6.1.
15. Tape overruns from rewind to stop.	Take -up reel brakes not functioning properly, worn or out of adjustment.	Replace or readjust, paragraph 7.2.2.2.6.1.
16. Take-up or fast forward inoperative, noisy or irregular drive.	Take -up clutch out of adjustment.	Adjust or replace, paragraph 7.2.2.2.8.
	Drive pin missing.	Replace, paragraph 7.2.2.2.8.2e.
	Brakes dragging on supply reel.	Adjust brakes, paragraph 7.2.2.2.6.1.
	Take -up reel support plate dirty or damaged.	Clean, lubricate or replace, paragraph 7.2.2.2.8.
	Noisy take-up or fast forward.	Check, paragraph 7.2.2.2.8.3.
	Damaged or worn idler.	Replace.
	Reel take-up support plate spring broken.	Replace.
17. Tape overruns from fast forward to forward position.	Supply reel brakes not functioning properly, worn or out of adjustment.	Replace or readjust, paragraph 7.2.2.2.6.2.
	Pinch roller damaged.	Replace.
18. Noisy running in stop and forward positions.	Damaged or worn idlers, dry bearings or flat spots on idlers.	Clean, lubricate or replace.
19. Tape flares out of supply reel from stop to forward position.	Dirty or worn pinch roller,	Lubricate or replace.
	Pinch roller lever assemblies out of adjustment or damaged.	Adjust or replace, paragraph 7.2.2.2.5.1.
20. Remote lever assembly not functioning properly.	Broken return spring or dirty lever assembly.	Clean, lubricate or replace spring.
	Pinch roller does not disengage capstan.	Adjust lever assembly, paragraph 7.2.2.2.5.1.
21. Tape flares out on supply reel when engaging remote lever assembly.	Damaged or worn supply reel brake or broken spring.	Replace, paragraph 7.2.2.2.8.
22. Control knob inoperative.	Loose set screw in knob.	Tighten.
	Loose set screws in pinch roller cam assembly.	Adjust and tighten.
23. Machine inoperative when control knob is operated.	Damaged or worn cam and shaft assembly.	Replace, paragraph 7.2.3.5.

7.2.2 TESTING REPAIR AND ADJUSTMENT

All servicing of the recorder (except cleaning of the head assembly, adjustment or replacement of brake lever assemblies, remote lever assembly, pinch roller and lever assemblies, pressure pad assembly, or replacement of the fuse) requires removal of the equipment from the case. It will be found that most repairs can be made after following the preliminary disassembly procedure given below in section 7.2.2.1. Section 7.2.3 gives further disassembly instructions which may be followed as needed.

7.2.2.1 PRELIMINARY DISASSEMBLY

7.2.2.1.1 Remove record head cover (18) by removing one screw (19). (Numbers in parentheses refer to figures 26 and 27.)

7.2.2.1.2 Remove all knobs and two screws (17) under control knob. Move plastic cover (16) about 1/16-inch toward f rent and lift off.

7.2.2.1.3 Remove seven screws (14) and two screws (13) in panel and lift panel from mechanism assembly.

7.2.2.1.4 Carefully turn recorder on its side so that accessories compartment is down, and slide amplifier and mechanism assembly out several inches.

7.2.2.1.5 Detach speaker plug and complete removal of amplifier and mechanism assembly.

7.2.2.1.6 Remove screws (59) around bottom of amplifier chassis and remove chassis bottom cover.

7.2.2.2 MECHANISM ASSEMBLY

7.2.2.2.1 REPAIR OF MECHANISM ASSEMBLY

(a) Clean head face, flywheel capstan, pinch roller, and tape guide spacers with a clean cloth dampened with chemically pure carbon tetrachloride to remove accumulated tape dirt.

(b) Clean oil, grease, and dirt from all rubber and metal drive surfaces with a clean cloth dampened as above.

CAUTION

Do not allow cleaning fluid to stand on rubber surfaces. Blow dry immediately.

(c) Inspect rubber drive surfaces for dents or cracks and replace with spares if in bad condition.

NOTE

Any flat spots or dents which result in excessive wow may be removed by ruining the mechanism for several hours in the drive position.

(d) Clean oil, grease, and dirt from bushings, shafts, and sliding surfaces and inspect for wear. DO NOT SOAK OILITE BEARINGS IN CLEANING FLUID; LIGHTLY WIPE DIRT FROM ENDS.

(e) Soak pressure pads and felt washers in chemically pure carbon tetrachloride to remove dirt and dry or replace, if hard.

7.2.2.2.2 TESTING AND ADJUSTMENTS

The equipment should be tested while removed from the case to permit access to the mechanism and amplifier. Attach mechanism to amplifier, make motor, speaker, and head connections, and slip knobs on shafts. Set equipment on a stand which will keep the steel panel level and will allow viewing the mechanism and amplifier.

7.2.2.2.3 Turn control knob to FORWARD and observe whether the pads engage the head groove and press against the pole pieces. Bend pressure pad spring and arm to obtain uniform pressure.

7.2.2.2.4 ALIGNING HEAD AND PRESSURE PADS.

(a) Set up the equipment for reproducing per paragraphs 6.1 and 6.3, using a tape recorded with music of good frequency range.

(b) Turn control knob to FORWARD while observing that pressure pads press tape to head lightly but evenly just before tape starts to drive.

(c) Bend pad arms so they move straight into head groove.

(d) Turn VOLUME and TONE controls to their mid-points and listen that the output is at normal listening level without excess bass or treble.

(e) Adjust the three head mounting screws (104) so that the tape passes over the head without rubbing on either side of the tape groove.

(f) Rotate the head slightly about vertical axis for best frequency response while adjusting screws.

7.2.2.2.5 REMOTE CONTROL ADJUSTMENT

If the pinch roller (55) does not engage the capstan with the remote lever in the stop position, adjust the tab per paragraph 7.2.2 .2.5.1 to which the lever spring is hooked so that, with the remote lever in the stop position, the pinch roller clears the capstan by about 1/64 to 1/32 inch. Release the lever assembly and check that the tab on the remote lever assembly clears the pinch roller lever arm assembly. Slowly push the remote lever while observing the action of the brake lever assembly (69) and pinch roller (55). The brake should touch the cup on the reel shaft assembly (70) just before the pinch roller leaves the capstan.

7.2.2 .2.5.1 PINCH ROLLER ADJUSTMENT

Adjust the tab on the follower lever assembly (51) so the pinch roller (55) engages the flywheel capstan

just before the brake lever assembly (69) releases the reel shaft assembly (70), thus preventing flare-out of the tape on the supply reel when turning the control knob from STOP to FORWARD.

7.2.2.2.6 ADJUSTING BRAKE LEVER ASSEMBLY

7.2.2.2.6.1 If tape overruns from REWIND to STOP, adjust brake lever assembly.

(a) Turn control knob to REWIND position (counterclockwise) to the stop.

(b) Adjust by either bending brake lever assembly (69) or the stop on mechanism plate just enough to clear the cup disc on take-up reel shaft assembly (73). Clearance should not exceed 1/64 inch.

(c) Adjust brake lever so remote lever assembly (65) remains in forward position. Be sure brake lever at supply reel is held in the forward position by the remote lever assembly.

(d) If not, turn control knob to FAST FORWARD (clockwise) as far as possible and adjust brake lever at supply reel as above.

(e) Thread with tape and check for proper operation.

7.2.2.2.6.2 If tape overruns from FAST FORWARD to FORWARD check per paragraph 7.2.2.2.6.1, except as follows:

(a) Turn control knob to FAST FORWARD and adjust brake lever at supply reel.

(b) Check brake lever at take-up reel to be sure it is held in the forward position by the remote lever assembly.

(c) If not, turn control knob to REWIND (counterclockwise) as far as possible and adjust brake lever per paragraph 7.2.2.2.6.1.

7.2.2.2.7 ADJUSTING BRAKE ARM ASSEMBLY

If after completing adjustments of paragraph 7.2.2.2.6, overrun is not corrected on REWIND and FAST FORWARD adjust the position of or replace the brake arm assembly (101) at the supply reel pulley assembly.

(a) Check that the felt pad is securely fastened to the arm.

(b) Turn the control knob to FAST FORWARD (clockwise) as far as possible.

(c) Adjust the brake arm so the pad just clears the reel pulley assembly (71) but by no more than 1/64 inch.

7.2.2.2.8 CORRECTING TAKE-UP AND FAST FORWARD TROUBLES

7.2.2.2.8.1 If the take-up at FORWARD and FAST FORWARD is weak, turn the self locking wing nut (82) on the take-up shaft to increase the friction drive force.

7.2.2.2.8.2 If adjusting the wing nut does not remedy the trouble, proceed as follows:

(a) Remove wing nut, spring, washer, and reel pulley assembly (79 through 82).

(b) Clean and check felt washer in pulley to be sure it is not hard or loose from pulley.

(c) If washer is worn, replace; if not, remove retaining ring (74) and disc clutch (78) from shaft and check if drive pin (77) is still in place.

(d) Check U washer (76) height; it should have an uncompressed height of 3/32 inch.

(e) Inspect for broken roll pin (77).

(f) Reassemble and adjust wing nut for a torque of 4 inch-ounce between shaft and reel pulley assembly before slipping occurs.

7.2.2.2.8.3 If unit is noisy in FORWARD or FAST FORWARD, the bearing in the idler assembly (44) or on the flywheel and shaft assembly (83) may be dirty, dry, or worn.

(a) Replace the idler assembly if worn or clean accumulated dirt from tire.

(b) Clean the drive area of the flywheel and shaft assembly and of the supply reel pulley assembly (71).

(c) If still noisy, check bearing surface of take-up reel shaft assembly (73) and clean dirt off drive area of drive cup (79) on shaft assembly.

(d) Also check and clean supply reel shaft (70) bearing.

7.2.2.2.9 ADJUSTING RECORD LEVEL INDICATOR

(a) Set Up equipment for recording per paragraph 6.2, using either good quality radio or phonograph output.

(b) Turn the VOLUME control to its mid-point and adjust the record level indicator level control (R-27) so the record level indicator does not quite close at input peak levels.

(c) Play back the recorded material and listen for distortion or weak volume caused by improper level control setting.

(d) Listen for rumble or wowing caused by dented or slipping rubber drive surfaces.

7.2.2.3 AMPLIFIER ASSEMBLY

7.2.2.3.1 PRELIMINARY

(a) Connect to source of power, turn power switch to ON, and observe for wrong connections as evidenced by tubes or pilot light not lighting, or components or wiring getting abnormally hot.

(b) With the RECORD-LISTEN switch at LISTEN, check all voltages to chassis as indicated in figure 22, using a 5 megohm or higher impedance vacuum tube voltmeter.

(c) Turn VOLUME control to maximum setting and TONE control to BASS, and listen for a low volume a-c hum at speaker.

(d) Slowly turn TONE control to TREBLE and observe that the a-c hum decreases, and listen for a low volume rushing sound at full treble.

(e) Tap tubes lightly and listen for ringing sound at speaker, indicating a microphonics tube.

7.2.2.3.2 REPAIR OF AMPLIFIER ASSEMBLY

Repair of the amplifier assembly consists of testing components to be sure they are serviceable, replacing defective parts with new ones.

(a) Check all tubes on a tube tester.

(b) Check continuity of transformer and reactor windings.

(c) Check for leaky, shorted, or open capacitors.

(d) Check resistors for proper values.

(e) Check for defective switch contacts using an ohmmeter.

(f) Check for break in power cord.

(g) Inspect tube sockets for corroded or broken terminals.

7.2.3 DISASSEMBLY

7.2.3.1 Remove fuse holder nut, unsolder three leads, and remove fuse holder.

7.2.3.2 Unsolder red motor lead from terminal of a-c line switch.

7.2.3.3 Remove three screws (104) and remove head and can assembly.

7.2.3.4 Unsnap pilot lamp receptacle (245) from bracket on support plate assembly (85) and remove three screws (86) attaching mechanism assembly to amplifier assembly.

7.2.3.5 DISASSEMBLE DRIVE ASSEMBLY

(a) Remove screws (86), detach spring (42), and lift assembly off plate assembly (28).

(b) Loosen set screw and remove fan (92).

(c) Remove ring (97) and pull off washers, disc assembly, and washers (95, 96, 98, and 94).

(d) Loosen screws (22) and remove pulley assembly (93).

(e) Remove screws (100) and pull motor assembly off plate assembly (85).

(f) Remove nuts (91) and remove mounting plate (88).

7.2.3.6 DISASSEMBLE MECHANISM

Disassembly of the mechanism consists of unhooking springs, removing retaining rings or screws attaching assemblies to the mechanism plate studs, and disassembling assemblies. However, to remove a particular assembly or part, reference should be made to the illustrations and drawings to determine the extent to which disassembly must be performed to remove the assembly or part since complete disassembly of the mechanism may not be required. Obvious operations are not called out.

(a) Remove flywheel and shaft assembly (83).

(b) Remove idler assembly (44) and link assembly (43).

(c) Remove idler assembly (44), link assembly (50), and lever assembly (49).

(d) Remove idler assembly (44), link assembly (102) and lever assembly (101).

(e) Remove idler kickout lever (38).

(f) Loosen set screw (22) and remove reel pulley assembly (71), washers (72), reel shaft assembly (70) and washer (72).

(g) Remove wing nut (82), spring (81), and washer (80).

(h) Remove reel pulley assembly (79), disc clutch (78), pin (77), and U washer (76).

(i) Remove reel shaft assembly (73) and washers (72).

(j) Loosen set screw (22) and remove pinch roller cam (36) and cam and shaft assembly (35).

(k) Unhook springs, (68), remove brake lever assemblies (69) and remote lever assembly (65).

(1) Remove screw (59), pinch roller assembly (55), and pinch roller and follower lever assemblies (52 and 51).

(m) Remove pressure pad assembly (60).

(n) Remove tape guide tops, spacers, and shelves (63, 62, and 61).

(o) Remove left and right reel shaft support assemblies (29 and S4).

(p) Remove head and can assembly (103).

7.2.3.7 DISASSEMBLY OF AMPLIFIER ASSEMBLY

Disassembly of the amplifier shall be accomplished only to the extent required for locating defective components and the replacement thereof. Cut leads and wires as close as possible to the soldered joints so that sufficient slack will be left for at least one resoldering operation.

(a) Loosen clamps (142, 146, 201, and 204), remove shields (133, 205 and 206), and pull tubes (195 through 200) and capacitors (194) from sockets.

(b) Remove fuse and holder (113 and 114).

(c) Remove resistor boards (165, 176, 186, 187, and 188) and unsolder components.

(d) Remove transformers (108 and 111) and reactor (112).

(e) Remove capacitors (158, 164, and 178).

(f) Remove oscillator compartment cover and end plate assembly (212 and 218) and remove resistor board (180).

(g) Remove potentiometers (115 and 116), switches (117, 148, 190, and 221), and jacks (120 and 121). Do not disassemble switch (148).

(h) Remove oscillator transformer (174).

(i) Remove tube sockets (135, 139, 147, and 193) and tube mounting plate assembly (126).

(j) Disassemble record lock arm assembly (156) and interlock plate assembly (216) from chassis assembly (107).

7.2.3.8 REASSEMBLE MECHANISM

Before slipping lever assemblies over studs and shafts into bearings, apply a small drop of oil and apply a thin film of Liqui-Moly NV grease or equivalent on cams and sliding surfaces.

(a) Temporarily attach head and can assembly (103) until alignment.

(b) Attach left and right reel shaft support assemblies (29 and 34) and springs (33).

(c) Attach tape guide shelves, spacers, and tops (61, 62, and 63).

(d) Attach pressure pad assembly (60).

(e) Attach follower lever, pinch roller and assemblies (51 and 52) and install pinch roller assembly (55).

(f) Install remote lever assembly (65) and brake lever assemblies (69) and attach springs (68).

(g) Insert cam and shaft assembly (35) and fasten pinch roller cam (36) with set screw (22), allowing 0.002 inch end play.

(h) Insert reel shaft assembly (73) from top with one washer (72). Slip another washer (72) over the shaft and install ring (74).

(i) Replace washers (75 and 76), pin (77), and clutch disc (78).

(j) Be sure pad (48) is securely cemented to reel pulley assembly (79), install ring (74), and replace pulley assembly with washer, spring, and nut (80, 81, and 82). Adjust nut for 4 inch-ounce torque between shaft and pulley assembly before slipping occurs.

(k) Insert reel shaft assembly (70) with one washer (72), slip on washers and reel pulley assembly (71), and fasten with set screw (22).

(1) Attach idler kickout lever (38).

(m) Slip idler assembly (44) on link assembly (102) attach to lever assembly (101) and attach to mechanism plate.

(n) Slip idler assembly (44) on link assembly (50) attach to lever assembly (49) and to assembly noted above.

(o) Attach idler assembly (44) to link assembly (43) and attach to mechanism plate.

(p) Adjust pinch roller cam assembly (36) relative to cam and shaft assembly (95) exactly as shown in Mechanical Assembly drawing top and bottom views. Note positions of roller (40) and pressure pad assembly (60).

(q) Slip flywheel and shaft assembly (83) into bearing.

(r) Set ball (84) in end of shaft assembly (83).

7.2.3.9 REASSEMBLE DRIVE ASSEMBLY

(a) Attach mounting plate (88) to motor (87).

(b) Attach plate assembly (85) to motor assembly with washers (90 and 99) and screws (100) on shock mounts (89).

(c) Attach pulley assembly (93) to motor shaft with set screw (22).

(d) Slip washer, clutch disc assembly, D washer, and spring tension washer (94, 98, 95, and 96) on motor pulley assembly (93), compress washer (96), and attach ring (97).

(e) Attach fan (92).

7.2.3.10 REASSEMBLY OF AMPLIFIER ASSEMBLY

(a) Attach interlock plate assembly (216) to chassis assembly (107).

(b) Slip record lock arm assembly (156) on switch (148) and install switch. Lock arm assembly in the position shown on Electronics Assembly drawing top and front views using set screws (157 and 22).

(c) Attach tube sockets (135, 139, 147, and 193) and tube mounting plate assembly.

(d) Attach oscillator transformer (174), install components on resistor board assembly (180), wire to transformer with leads extending out grommet (211), and install compartment cover and end plate assembly (212 and 218).

(e) Install potentiometers (115 and 116), switches (117, 148, and 221), and jacks (120 and 121).

(f) Attach capacitors (158, 164, and 178).

(g) Attach transformers (108 and 111) and reactor (112).

(h) Solder components to terminal board assemblies (23 1 through 236) and install assemblies.

(i) Install fuse and holder (113 and 114).

(j) Solder all connections as shown in the Schematic Wiring diagram, carefully observing that no rosin or cold solder joints are allowed and that component leads do not short against ground or other components.

(k) Push tubes (195 through 200) and capacitor (194) into sockets, install shields (133, 205, and 206), and tighten clamps (142, 146, 201, and 204).

7.2.4 FINAL ASSEMBLY AND TEST

(a) Install speaker and baffle assembly (3 and 8) with plug and wire assembly (11) in case (l).

(b) Install fuse holder and solder three leads.

(c) Attach head and can assembly with three screws (104).

(d) Snap pilot lamp receptacle (245) onto bracket on support plate assembly (85) and attach mechanism assembly to amplifier assembly wIth three screws.

(e) Solder red motor lead to a-c line switch.

(f) Attach bottom plate (9) to amplifier chassis (107) with screws (59).

(g) Set mechanism and amplifier assembly over case, connect head leads, connect speaker plug to jack (121), and slip assembly into case. Be sure fan (92) does not hit speaker cord.

(h) Attach top panel assembly (12) and mechanism plate assembly (28) to case with screws and washers (13, 14, and 15).

(i) Attach plastic cover (16) with screws (15).

(j) Attach plastic cover (18) with screw and washer (15 and 19).

(k) Install knobs (21, 23, and 66).

(1) Test equipment per paragraphs 4.1.1 and 4.1.2.

SECTION 8
PARTS IDENTIFICATION

8.1 LIST OF ELECTRICAL PARTS

SYM.	PC. NO.	NAME	FUNCTION	JAN TYPE NO.	MFR	MFR'S NO.	STD NAVY STOCK NO.
C-1	149	Capacitor	Head Peaking		16	241-20043-4	
C-2	158	Capacitor	Cathode Bypass		16	241-20051	
C-3	173	Capacitor	Screen Bypass		16	241-20063	
C-4	194	Capacitor	DC Filter		16	241-20056	
C-5	164	Capacitor	DC Blocking and Coupling		16	241-20057	
C-6	158	Capacitor	Cathode Bypass		16	241-20051	
C-7	164	Capacitor	DC Blocking and Coupling		16	241-20057	
C-8	194	Capacitor	DC Filter		16	241-20056	
C-9	185	Capacitor	HF Pre-emphasis		16	241-20043-2	
C-10	189	Capacitor	Base Compensating		16	241-24291-1	
C-11	241	Capacitor	Base Compensating		16	241-24291-2	

SYM.	PC. NO.	NAME	FUNCTION	JAN TYPE NO.	MFR	MFR'S NO.	STD NAVY STOCK NO.
C-12	172	Capacitor	Tone Control Network		16	241-20074-1	
C-13	164	Capacitor	DC Blocking and Coupling		16	241-20057	
C-14	158	Capacitor	Cathode Bypass		16	241-20051	
C-15	178	Capacitor	Frequency Compensating		16	241-20099	
C-16	183	Capacitor	Time Constant		16	241-20074-2	
C-17	183	Capacitor	Oscillator Tuning		16	241-20074-2	
C-18	184	Capacitor	Erase Coupling		16	241-20074-3	
C-19	171	Capacitor	Bias Coupling		16	241-20043-3	
C-20	164	Capacitor	AF Coupling		16	241-20057	
C-21	179	Capacitor	RF Bypass		16	241-20053	
C-22	173	Capacitor	Time Constant		16	241-20063	
C-23	179	Capacitor	RF Bypass		16	241-20053	
C-24	194	Capacitor	DC Filter		16	241-20056	
C-25	194	Capacitor	DC Filter		16	241-20056	
C-26	179	Capacitor	RF Bypass		16	241-20053	
C-27	242	Capacitor	Base Compensating		16	241-24291-3	
F-1	114	Fuse	Line		1	241-20012	
I-1	246	Pilot Lamp	Power-on Indicator		21	P8914	
J-1	120	Jack	MIC Input		5	241-20018	
J-2	121	Open Circuit Jack	Bridging Input		5	241-20019-1	
J-3	120	Closed Circuit Jack	External Speaker		5	241-20018	
J-4	121	Open Circuit Jack	Internal Speaker		5	241-20019-1	
L-1	112	Reactor	Choke			242-19978	
L-2	103	Head	Record-Reproduce			242-14159	
L-3	103	Head	Erase			242-14159	
LS-1	8	Speaker	Reproduction		28	241-19906	
MI-1	20	Microphone	Recording		31	241-19914	
R-1	122	Resistor	Input Impedance		6	29501-28	
R-2	123	Resistor	Input Impedance		6	29501-6	
R-3	182	Resistor	Grid Bias		6	29501-53	
R-4	159	Resistor	Cathode Return		6	29501-11	
R-5	151	Resistor	Screen Dropping		6	29501-57	
R-6	152	Resistor	Plate Dropping		6	29501-44	
R-7	177	Resistor	Voltage Dropping		6	29501-29	
R-8	115	Potentiometer	Volume Control		2	241-20013	
R-9	166	Resistor	Base Compensating		6	29501-48	
R-10	160	Resistor	Cathode Return		6	29501-14	
R-11	166	Resistor	Plate Dropping		6	29501-48	
R-12	167	Resistor	Bass Compensating		6	29501-41	
R-13	167	Resistor	Bass Compensating		6	29501-41	
R-14	230	Resistor	Bass Compensating		6	29501-23	
R-15	182	Resistor	Bass Compensating		6	29501-53	
R-16	151	Resistor	Bass Compensating		6	29501-57	
R-17	168	Resistor	Voltage Dropping		6	29501-21	
R-18	115	Resistor	Tone Control		2	241-20013	
R-19	160	Resistor	Cathode Return		6	29501-14	
R-20	166	Resistor	Plate Dropping		6	29501-48	
R-21	166	Resistor	Grid Bias		6	29501-48	
R-22	163	Resistor	Cathode Return		6	29501-98	
R-23	150	Resistor	Feedback		6	29501-24	
R-24	169	Resistor	Transformer Loading			241-20049	
R-25	181	Resistor	Grid Bias		6	29501-76	
R-26	182	Resistor	Voltage Dropping		6	29501-53	
R-27	116	Potentiometer	Indicator Level		2	241-20014	
R-28	152	Resistor	Plate Return		6	29501-44	
R-29	151	Resistor	Plate Load		6	29501-57	
R-30	170	Resistor	Grid Bias		6	29501-60	
S-1	117	Switch	Line		3	241-20015	
S-2	148	Selector Switch	Record-Reproduce		15	241-20041	
S-3	221	Switch	Speaker			241-20077	
S-4	190	Switch	Speed Selector		15	241-24293	
T-1	108	Transformer	Power			242-19974	
T-2	111	Transformer	Output			242-19976	
T-3	174	Transformer	Oscillator		18	241-14246-2	

SYM.	PC. NO.	NAME	FUNCTION	JAN TYPE NO.	MFR	MFR'S NO.	STD NAVY STOCK NO.
V-1	197	Electron Tube	Reproduce Amplifier		20		
V-2	196	Electron Tube	Record-Reproduce Amplifier		21		
V-3	228	Electron Tube	Record Level Indicator Rectifier		21		
V-4	195	Electron Tube	Record-Reproduce Output		21		
V-5	198	Electron Tube	Erase and Bias Oscillator		21		
V-6	200	Electron Tube	Record Level Indicator		20		
V-7	199	Electron Tube	Rectifier		21		

8.2 LIST OF MANUFACTURERS

CODE NO.	MANUFACTURER	ADDRESS	
1	Bussmann Manufacturing Co.	University at Jefferson	St. Louis 7, Mo.
2	Chicago Telephone Supply Corp.	1142 W. Beardsley	Elkhart, Indiana
3	Cutler-Hammer Inc.	372 N. 12 St.	Milwaukee 1, Wisconsin
4	Acme Electronics Inc.	300 N. Lake Ave.	Pasadena 4, California
5	Switchcraft Inc.	1340 N. Halsted St.	Chicago 22, Illinois
6	Allen-Bradley Co.	136 W. Greenfield Ave.	Milwaukee 11, Wisconsin
7	Continental Diamond Fibre Co.	3208 Palmolive Bldg.	Chicago 11, Illinois
8	Micarta Fabricators Inc.	5324 Ravenswood Ave.	Chicago 40, Illinois
9	United Shoe Machinery Co.	922 N. Fourth St.	Milwaukee 1, Wisconsin
10	Eby, Hugh H., Inc.	4700 Stenton Ave.	Philadelphia 44, Pa.
11	Protective Closures Co., Inc.	2207 Elmwood Ave.	Buffalo 22, New York
12	Shakeproof, Inc. Div. Illinois Tool Works	St. Charles Road	Elgin, Illinois
13	Mallory & Co, Inc., P. R.	3029 E. Washington St.	Indianapolis 6, Indiana
14	The Birtcher Corporation	4371 Valley Boulevard	Los Angeles 32, California
15	Oak Manufacturing Co.	1260 Clybourn Ave.	Chicago 10, Illinois
16	Cornell-Dubilier Electric Corp.	333 Hamilton Boulevard	South Plainfield, N. J.
17	Lenz Electric Manufacturing Co.	1751 N. Western Ave.	Chicago 47, Illinois
18	Linell Engineering Corp., Charles S.	447 South Boulevard	Oak Park, Illinois
19	Drake Manufacturing Co.	1713 W. Hubbard St.	Chicago, Illinois
20	RCA Victor Division Radio Corporation of America		Chicago, Illinois
21	General Electric Co. Tube & Lamp Division		Chicago, Illinois
22	Tinnerman Products, Inc.	P. O. Box 6688	Cleveland 1, Ohio
23	Lavelle Rubber Co.	424 N. Wood St.	Chicago 22, Illinois
24	Belden Manufacturing Co.	4641 W. Van Buren St.	Chicago 44, Illinois
25	(Heyco) D. J. Campbell	517 E. Buffalo St.	Milwaukee 2, Wisconsin
26	Spalding Fibre Co.	3329 W. Vliet St.	Milwaukee 8, Wisconsin
27	North Bay Leather Co.	1215 State Street	Racine, Wisconsin
28	Oxford Electric Corporation	3911 S. Michigan Ave.	Chicago 15, Illinois
29	Ken-Well	122 Logan St.	Frankfort, Kentucky
30	Gits Moulding Corp.	4600 W. Huron St.	Chicago 44, Illinois
31	Shure Bros.	225 W. Huron St.	Chicago 10, Illinois
32	Minnesota Mining & Mfg. Co.		St. Paul 6, Minnesota
33	Reeves Soundcraft Corporation	10 E. 52nd St.	New York 22, New York
34	National Lockwasher Co.	241 E. Erie St.	Milwaukee, Wisconsin
35	Midwest Spring Manufacturing Co.	4636 S. Western Ave.	Chicago, Illinois
36	Precision Fabricators Inc.	Box 270	E. Rochester, New York
37	Booth Felt Co.	9611 Cottage Grove Ave.	Chicago 28, Illinois
38	Elastic Stop Nut Corporation	2330 Vauxhall Road	Union, New Jersey
39	Universal Electric Corporation	5254 W. Madison St.	Chicago 44, Illinois
40	Lord Manufacturing Co.		Erie, Pa.
41	Accurate Spring Manufacturing Co.	2041 W. State St.	Milwaukee 3, Wisconsin
42	Hoover Ball & Bearing Co.		Ann Arbor, Michigan
43	Wrought Washer Manufacturing Co.		Milwaukee, Wisconsin
44	National Vulcanized Fibre		Wilmington 99, Delaware
45	Cinch Manufacturing Co.	1026 S. Homan Ave.	Chicago 24, Illinois
46	Amphenol Electronics Corp.		Chicago, Illinois

PC. NO.	NAME	PART NO.	QTY.
37	Grommet	241-14213	3
44	Idler Assembly	242-17719-6	3
55	Pinch Roller Assembly	242-17744-2	1
60	Pressure Pad Assembly	242-17748-2	1
48	Clutch Washer	241-12145	1
94	Flat Washer	241-17790-1	1
103	Head and Can Assembly	242-14159	1

8.6 Frequency Response Test

a. Test Equipment and Materials.

Audio Oscillator TS–382(*)/U
Electronic Voltmeter ME–30(*)/U
Output Meter TS–585(*)/U
Cord CD–1252/U, 2 each
1 reel recording tape (part of RD–173(*)/UN)

b. Test Connections and Conditions. Connect equipment as shown in figure 21.2. Place reel of tape and takeup reel on machine and thread for normal operation.

c. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	*TS–382(*)/U:* OUTPUT LEVEL: Full counterclockwise. RANGE: X10 Tuning: 20 ATTENUATOR: 10 OCS: ON *TS–585(*)/U:* Impedance control: 30 in X.1 quadrant. MULTIPLY BY: –10 db. *ME–30(*)/U:* VOLTS DB: 3 + 10 ON-OFF: ON	Control knob: STOP POWER: ON SPEAKER: ON TONE: midscale VOLUME: midscale SPEED SELECTOR: 7½	*a.* Adjust TS–382(*)/U OUTPUT LEVEL until ME–30(*)/U indicates 1 volt (1 on center 0–3 scale). *b.* Press RD–173(*)/UN interlock button (next to RECORD-LISTEN switch) and, at the same time, set RECORD-LISTEN switch to RECORD. *c.* Adjust RD–173(*)/UN VOLUME control to point where record level indicator (electric eye) closes but does not overlap. *d.* Set the RD–173(*)/UN control knob to FORWARD. Repeat step *b* above. *e.* Repeat step *c* above if necessary. *f.* Slowly increase TS–382(*)/U tuning up to 200 while keeping RD–173/UN record level indicator closed but not overlapping by adjustment of the VOLUME control. *g.* Return TS–382(*)/U tuning to 20. Set RANGE switch to X100. *h.* Slowly increase TS–382(*)/U tuning up to 50 while keeping RD–173(*)/UN record level indicator closed but not overlapping by adjustment of the VOLUME control. *i.* Set RD–173(*)/UN control knob to STOP. Set control knob to REWIND. Rewind tape to starting point.	*a.* None. *b.* None. *c.* None. *d.* RD–173(*)/UN should start recording. *e.* None. *f.* None. *g.* None. *h.* None. *i.* None.
2	Same as step 1.	Same as above plus: RECORD-LISTEN: LISTEN	*a.* Set RD–173(*)/UN control knob to FORWARD. *b.* Adjust RD–173(*)/UN VOLUME control for an indication of 10 db on TS–585(*)/U. *c.* Observe TS–585(*)/U indication for entire portion recorded in step 1. *d.* At end of recorded portion, place a small piece of paper in tape on reel or mark the end of recording in some other way.	*a.* RD–173(*)/UN should start to play back. *b.* None. *c.* Output should not vary more than ±2 db on TS–585(*)/U (between 8 and 12 db on upper scale). *d.* None.
3	Same as step 1.	Same as step 1, except: SPEED SELECTOR: 3¾	*a.* Repeat steps 1*a* through *g*. *b.* Slowly increase TS–382(*)/U tuning up to 30 while keeping RD–173(*)/UN record level indicator closed but not overlapping by adjustment of the VOLUME control. *c.* Set RD–173(*)/UN control to STOP. Set control knob to REWIND. Rewind tape to point marked by piece of paper mentioned in step 2*d*.	*a.* None. *b.* None. *c.* None.
4	Same as step 1.	Same as above plus: RECORD-LISTEN: LISTEN	*a.* Repeat steps 3*a* and *b*. *b.* Observe TS–585(*)/U indication for entire portion recorded in step 3. *c.* Remove paper marker from tape reel. Do not remove tape from machine. *d.* Move control knob to STOP.	*a.* None. *b.* Same as step 2*c*. *c.* None. *d.* None.

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8.7 Distortion and Output Level Test

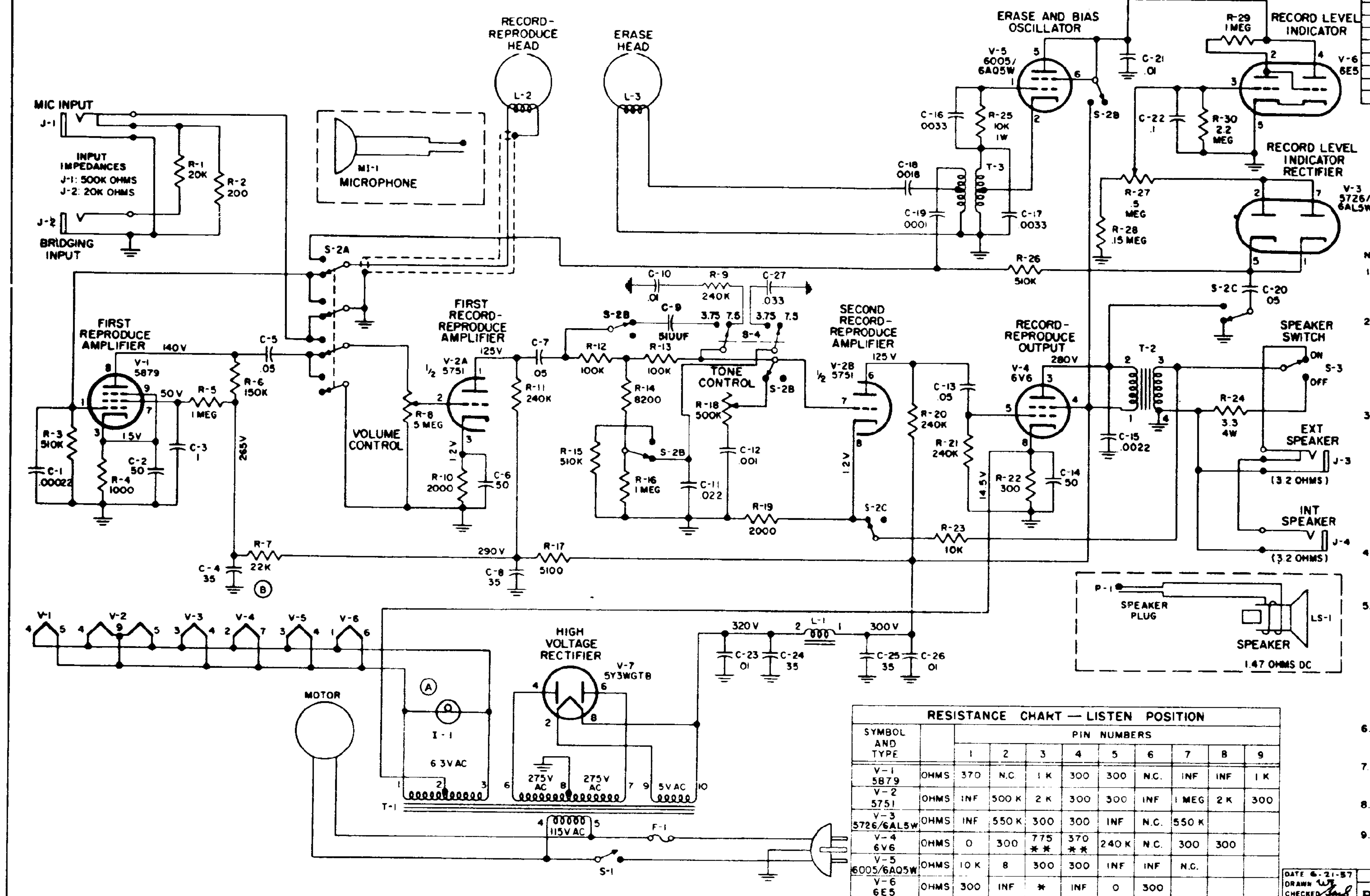
a. Test Equipment and Materials.

Audio Oscillator TS–382(*)/U
Output Meter TS–585(*)/U
Spectrum Analyzer TS–723(*)/U
Cord CD–1252. 2 each
Cord CG–409/U
Adapter UG–514/U

b. Test Connections and Conditions. Connect equipment as shown in figure 21.3. Advance tape on recorder to a point well removed from portion used in previous tests. Mark this spot with a small piece of paper.

c. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	*TS–382(*)/U* OUTPUT LEVEL: midscale. RANGE: X10 Tuning: 20 ATTENUATOR: 1 OSC: ON *TS–585(*)/U* Impedence control: 30 in X.1 quadrant MULTIPLY BY: $\frac{+20}{100}$ *TS–723(*)/U* INPUT: MIN AF–RF: AF Meter range switch: 100% Function: SET LEVEL ON-OFF: ON RANGE: X10 FREQUENCY (upper): 20	Control knob: STOP POWER: ON SPEAKER: ON TONE: midscale VOLUME: midscale SPEED SELECTOR: 7½	*a.* Press RD–173(*)/UN interlock button (next to RECORD-LISTEN switch) and at same time set RECORD-LISTEN switch to RECORD. *b.* Adjust RD–173(*)/UN VOLUME control to point where record level indicator (electric eye) closes but does not overlap. *c.* Set RD–173(*)/UN control knob to FORWARD. Repeat step *a* above. *d.* Record approximately 2 minutes of tone. *e.* Adjust RD–173(*)/UN VOLUME control to minimum. *f.* Adjust TS–382(*)/U main tuning dial to 100. *g.* Repeat step *b* above. *h.* Repeat step *d* above. *i.* Repeat step *e* above. *j.* Adjust TS–382(*)/U main tuning dial to 200. *k.* Repeat step *b* above. *l.* Repeat step *d* above. *m.* Repeat step *e* above. *n.* Adjust TS–382(*)/U main tuning dial to 50 and set RANGE switch to X100. *o.* Repeat step *b* above. *p.* Repeat step *d* above. *q.* Set RD–173(*)/UN control knob to STOP. Place a small piece of paper in tape at this point to mark end of recording. *r.* Set RD–173(*)/UN control knob to REWIND. Rewind tape to paper marker at starting point of this recording mentioned in *Test Connections and Conditions* above.	*a.* None. *b.* None. *c.* None. *d.* None. *e.* None. *f.* None. *g.* None. *h.* None. *i.* None. *j.* None. *k.* None. *l.* None. *m.* None. *n.* None *o.* None. *p.* None. *q.* None. *r.* None.
2	Same as step 1.	Same as step 1.	*a.* Read and become familiar with steps *b* through *i* below (because of limited amount of time each tone is recorded on tape (approximately 2 minutes)). *b.* Set RD–173(*)/UN control knob to FORWARD. Adjust VOLUME control for 2.2-watt indication on TS–585(*)/U (22 on lower scale). *c.* Rotate TS–723(*)/U INPUT control until meter pointer reaches full-scale deflection of 1.0. *d.* Set TS–723(*)/U function switch to DISTORTION. *e.* Adjust TS–723(*)/U course FREQUENCY (upper) control until meter pointer dips sharply. As tuning progresses, decrease settings of meter range switch to maintain mid-scale meter deflections. *f.* Adjust TS–723(*)/U fine FREQUENCY (lower) control for maximum dip of meter. The tuning becomes sharper as meter reading decreases. *g.* Adjust TS–723(*)/U BALANCE control for minimum meter indication. *Note:* The RD–173(*)/UN must put out a stable signal in order to maintain a steady balance. *h.* Readjust TS–723(*)/U FREQUENCY and BALANCE controls until no further reduction in meter reading can be obtained. Set METER RANGE SWITCH to 10%. *i.* Adjust TS–723(*)/U INPUT control to MIN. Adjust RD–173(*)/UN VOLUME control maximum clockwise. *j.* Observe TS–585(*)/U as an indication of playback tone. Allow RD–173(*)/UN to play back past end of tone (TS–585(*)/U indication falls to 0) through blank section to start of next test tone recording (TS–585(*)/U indication). At this point, set RD–173(*)/UN control knob to STOP.	*a.* None. *b.* None. *c.* None. *d.* None. *e.* None. *f.* None. *g.* None. *h.* TS–723(*)/U should not indicate more than 5% distortion (0.5 on upper 0-1.0 scale). *i.* TS–585(*)/U should indicate at least 2.2 watts (22 on milliwatts scale). *j.* None.
3	Same as above except: *TS–723(*)/U* FREQUENCY (upper): 100	Same as step 1.	*a.* Repeat steps 2*a* through *h*. *b.* Repeat step 2*i*. *c.* Repeat step 2*j*.	*a.* Same as 2*h*. *b.* Same as 2*i*. *c.* None.
4	Same as above except: *TS–723(*)/U* FREQUENCY (upper): 20 RANGE: X100	Same as step 1.	*a.* Repeat steps 2*a* through *h*. *b.* Repeat step 2*i*. *c.* Repeat step 2*j*.	*a.* Same as step 2*h*. *b.* Same as step 2*i*. *c.* None.
5	Same as above except: *TS–723(*)/U* FREQUENCY (upper): 50	Same as step 1.	*a.* Repeat steps 2*a* through *h*. *b.* Repeat step 2*i*. *c.* Advance tape to point well ahead of end of test recordings (marked by paper mentioned in step 1*q*). *d.* Set RD–173(*)/UN control knob to STOP. Move piece of marker paper mentioned in *c* above to mark present position of tape on reels.	*a.* Same as step 2*h*. *b.* Same as step 2*i*. *c.* None. *d.* None.
6	Same as step 1.	Same as step 1, except: SPEED SELECTOR: 3¾	*a.* Repeat steps 1*a* through *m*. *b.* Adjust TS–382(*)/U main tuning dial to 30 and set RANGE switch to X100. *c.* Repeat steps 1*o* and *q*. *d.* Set RD–173(*)/UN control knob to REWIND. Rewind tape to paper marker at the starting point of this test procedure (point marked by paper in step 5*d*).	*a.* None. *b.* None. *c.* None. *d.* None.
7	Same as step 6.	Same as step 6.	*a.* Repeat steps 2*a* through *h*. *b.* Repeat step 2*i*. *c.* Repeat step 2*j*.	*a.* Same as step 2*h*. *b.* Same as step 2*i*. *c.* None.
8	Same as step 7 except: *TS–723(*)/U* FREQUENCY (upper): 100	Same as step 6.	*a.* Repeat steps 2*a* through *h*. *b.* Repeat step 2*i*. *c.* Repeat step 2*j*.	*a.* Same as step 2*h*. *b.* Same as step 2*i*. *c.* None.
9	Same as step 8 except: *TS–723(*)/U* FREQUENCY (upper): 20 RANGE: X100	Same as step 6.	*a.* Repeat steps 2*a* through *h*. *b.* Repeat step 2*i*. *c.* Repeat step 2*j*.	*a.* Same as step 2*h*. *b.* Same as step 2*i*. *c.* None.
10	Same as step 9, except: *TS–723(*)/U* FREQUENCY (upper): 30	Same as step 6.	*a.* Repeat steps 2*a* through *h*. *b.* Repeat step 2*i*. *c.* Set RD–173(*)/UN control knob to STOP.	*a.* Same as step 2*h*. *b.* Same as step 2*i*. *c.* None.

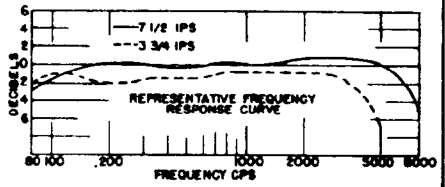


RESISTANCE CHART — LISTEN POSITION										
SYMBOL AND TYPE		PIN NUMBERS								
		1	2	3	4	5	6	7	8	9
V-1 5879	OHMS	370	N.C.	1 K	300	300	N.C.	INF	INF	1 K
V-2 5751	OHMS	INF	500 K	2 K	300	300	INF	1 MEG	2 K	300
V-3 5726/6AL5W	OHMS	INF	550 K	300	300	INF	N.C.	550 K		
V-4 6V6	OHMS	0	300	775 **	370 **	240 K	N.C.	300	300	
V-5 6005/6AQ5W	OHMS	10 K	8	300	300	INF	INF	N.C.		
V-6 6E5	OHMS	300	INF	*	INF	0	300			
V-7 5Y3WGTB	OHMS	N.C.	INF	N.C.	175	N.C.	160	N.C.	INF	

REVISIONS						
ZONE	REV	DESCRIPTION	DATE	APP'D	DATE	APP'D
	A	ADDED PILOT LAMP				
	B	WAS 220K				

NOTES

1. INPUT POWER:
   115V 60 CPS
   100 WATTS IN LISTEN
   106 WATTS IN RECORD
2. OUTPUT POWER:
   2.5 WATTS AT 5% TOTAL HARMONIC DISTORTION
   OUTPUT IMPEDANCE
   3.2 OHMS AT 1000 CPS
   AMPLIFIER POWER GAIN
   45 DB AT 1000 CPS
   HEAT DISSIPATION
   95.2 WATTS
3.



4. SELECTOR SWITCH SHOWN IN LISTEN POSITION
   S-2A INDICATES FRONT WAFER
   S-2B INDICATES CENTER WAFER
   S-2C INDICATES REAR WAFER
5. ALL VOLTAGES TAKEN FROM POINTS INDICATED TO CHASSIS USING HIGH RESISTANCE DC VACUUM TUBE VOLT METER WITH RECORD-LISTEN SWITCH IN LISTEN POSITION
   ALL RESISTORS 1/2 WATT UNLESS INDICATED, ALL RESISTANCE VALUES ARE IN OHMS
   MEG DESIGNATES 1,000,000 OHMS
   K DESIGNATES 1,000 OHMS
   ALL CAPACITANCE VALUES ARE IN MICROFARADS UNLESS INDICATED OTHERWISE
6. FOR VOLTAGE MEASUREMENTS TAKEN IN RECORD POSISTION, REFER TO WIRING DIAGRAM, S6502-2-3244410
7. (V-1, V-2, V-3, V-5, V-7) RESISTANCE TAKEN TO CHASSIS WITH C-24 & C-25 REMOVED & VOLUME CONTROL IN FULL CLOCKWISE POSITION
8. (*) RESISTANCE DEPENDS UPON SETTING OF R-27 (APPROX 300 K)
9. (**) RESISTANCE TAKEN TO PIN 8 OF V-7

DATE 6-21-57
DRAWN
CHECKED
APP'D
APP'D DATE

MASTER DRAWING

RECORDER REPRODUCER (MODEL N216) RD-173/UN SCHEMATIC WIRING DIAGRAM

SCALE NONE WT CALC ACTUAL

WEBSTER ELECTRIC CO.
RACINE, WISCONSIN
249-24447

NAVY DEPT BU SHIPS DWG NO			REV
S6502	H	3313771	A

CONT ON SHT —— SHT NO 1

Figure 22

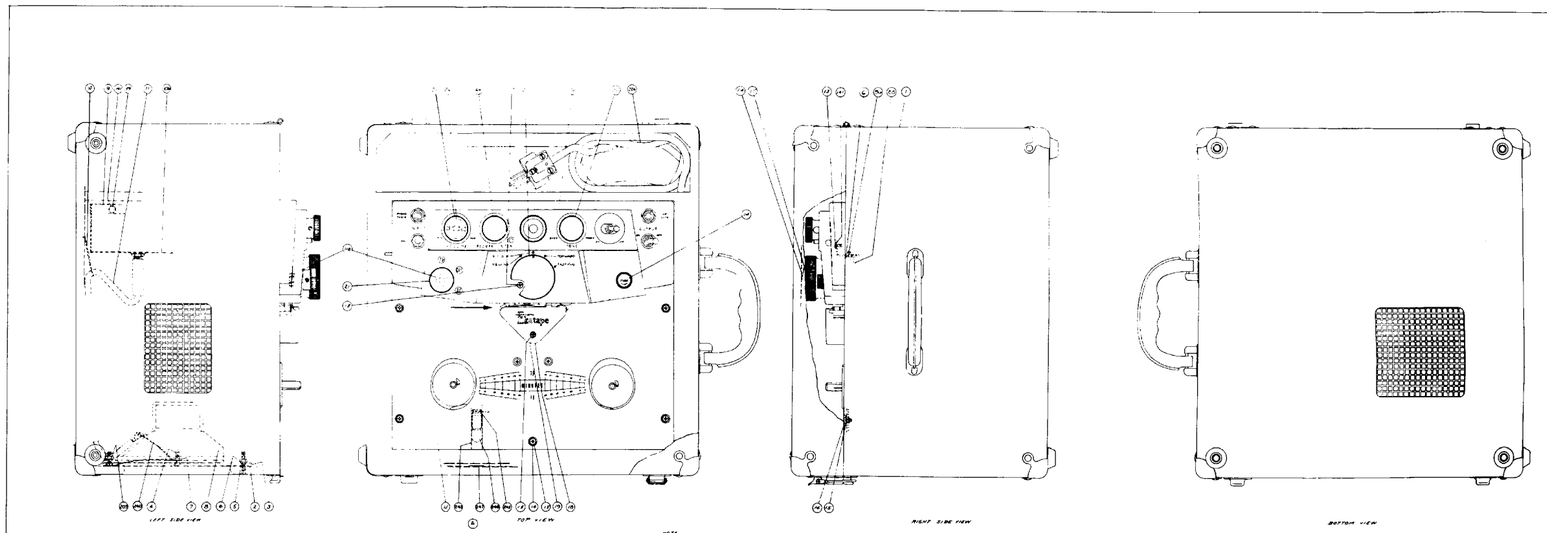

LEFT SIDE VIEW
TOP VIEW
RIGHT SIDE VIEW
BOTTOM VIEW
NOTE FOR ADDITIONAL ASSEMBLIES & PARTS LISTS SEE SHEETS 2 & 3
FOR PARTS LIST SEE SHEET 1 AB

Figure 33

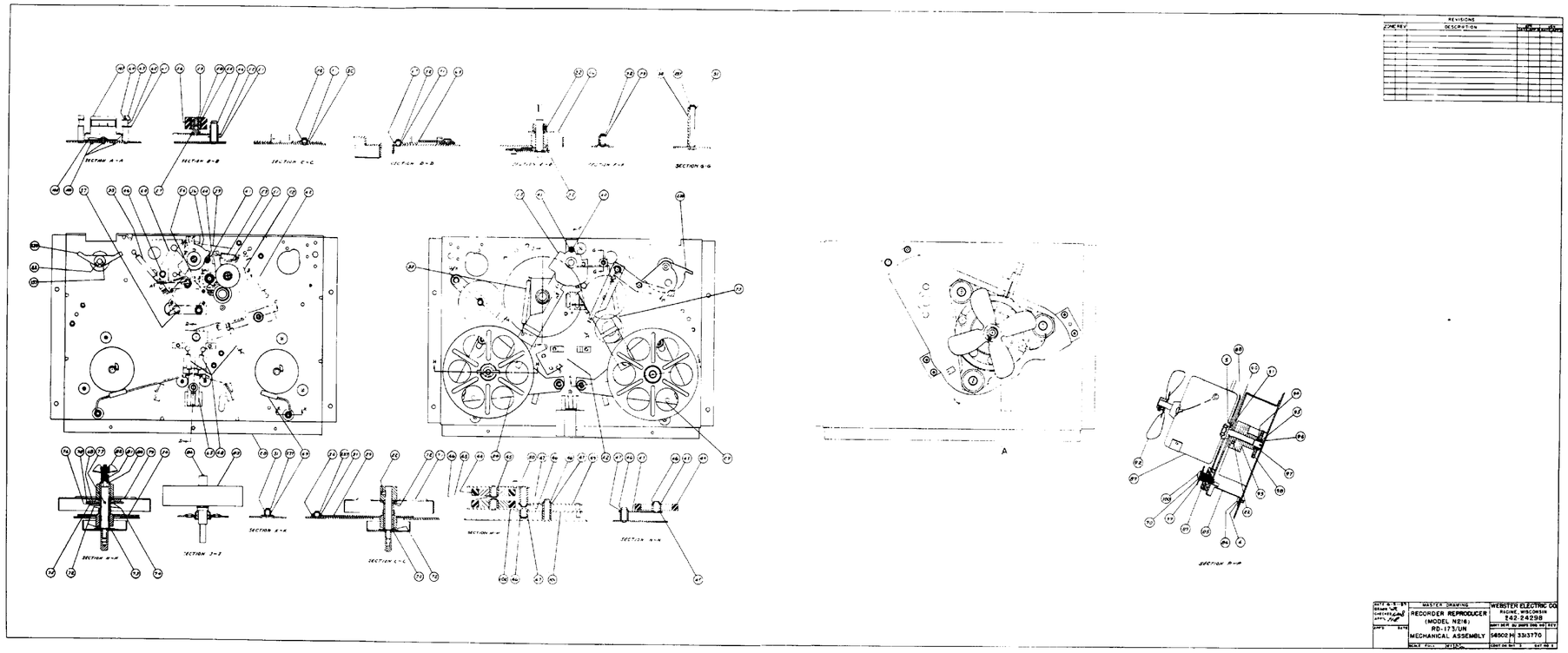

REVISIONS
ZONE REV. DESCRIPTION DATE APPROVED
MASTER DRAWING
RECORDER REPRODUCER
(MODEL N218)
RD-173/UN
MECHANICAL ASSEMBLY
WEBSTER ELECTRIC CO.
RACINE, WISCONSIN
T42-24298
56502 H 3313770
SECTION A-A
SECTION B-B
SECTION C-C
SECTION D-D
SECTION E-E
SECTION F-F
SECTION G-G
SECTION H-H
SECTION J-J
SECTION K-K
SECTION L-L
SECTION M-M
SECTION N-N
SECTION P-P
A

Figure 24

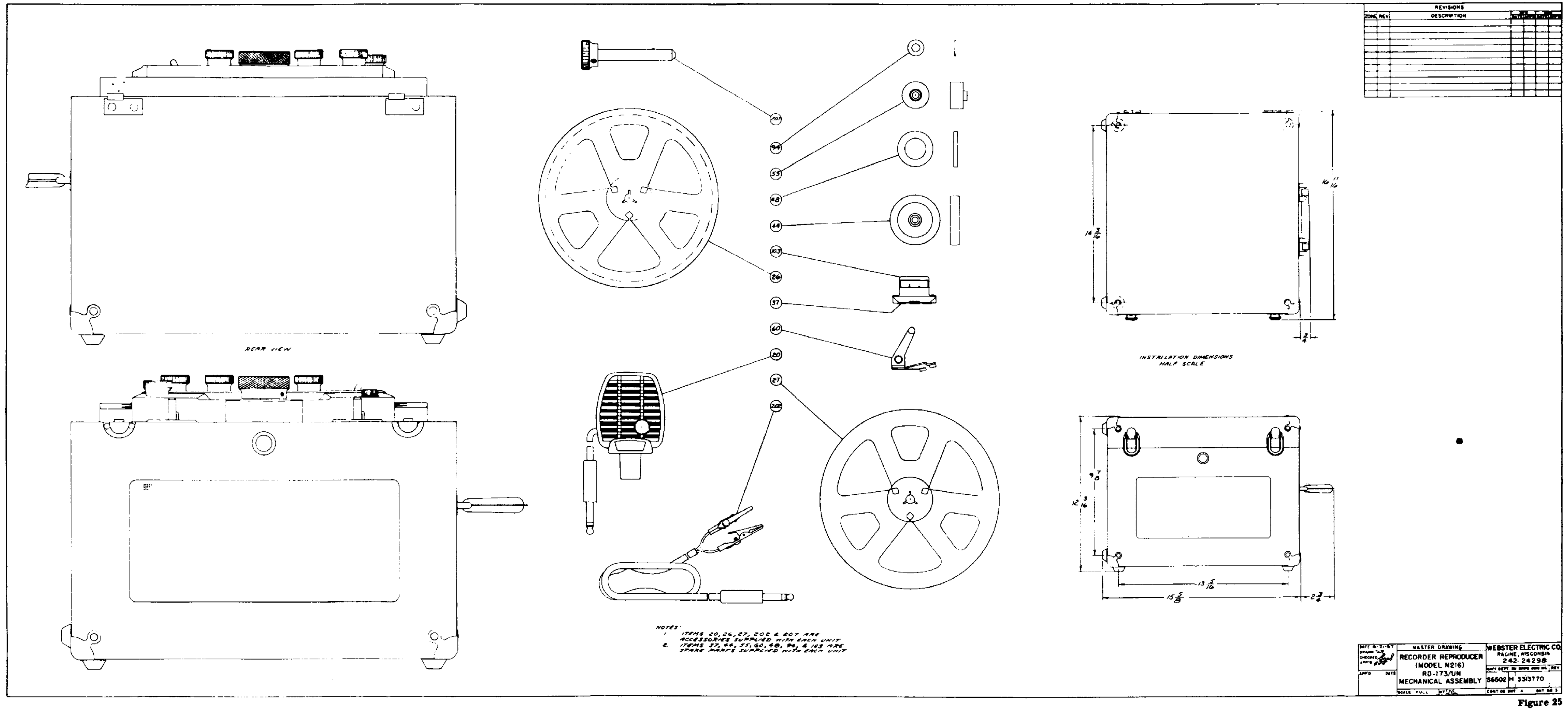

REVISIONS
REAR VIEW
INSTALLATION DIMENSIONS
HALF SCALE
NOTES:
1. ITEMS 20, 26, 27, 202 & 207 ARE ACCESSORIES SUPPLIED WITH EACH UNIT
2. ITEMS 37, 44, 55, 60, 48, 94, & 103 ARE SPARE PARTS SUPPLIED WITH EACH UNIT
MASTER DRAWING
RECORDER REPRODUCER
(MODEL N216)
RD-173/UN
MECHANICAL ASSEMBLY
WEBSTER ELECTRIC CO.
RACINE, WISCONSIN
242-24298
S6602 H 3313770
SCALE FULL

Figure 25

LIST OF MATERIAL QUANTITIES FOR ONE RECORDER REPRODUCER SOUND, RD 173/UN

PC NO.	NAME	NO. REQ'D	MATERIAL	MATL SPEC.	CONTRACTOR DWG NO. OR SERVICE PART NO.	MANUFACTURER NAME	MANUFACTURER SERVICE PART OR DWG NO	BUSHIPS DWG NO	UNIT WT LB	STD NAVY STOCK NO	REMARKS
61	SHELF, TAPE GUIDE	2	ST. ST.	COMM	241-17752						
62	SPACER, TAPE GUIDE	2	ST. ST.	COMM	241 17753						
63	TOP, TAPE GUIDE	2	ST. ST.	COMM	241 17754						
64	SCREW, RRHM 4-40 x 1/2	2	STEEL	COMM	29527 13						ZINC PLATE
65	LEVER ASSY, REMOTE	1			242 17755 2						ZINC PLATE
66	KNOB, RECORD	1	ALUMINUM	COMM	241 19915 1						ANODIZE
67	WASHER, FL. ([illegible])	1	STEEL	COMM	29602-122						ZINC PLATE
68	SPRING	3	MUSIC WIRE	COMM	241 17734	35					ZINC PLATE
69	LEVER ASSY, BRAKE	2			241 17758-4						ZINC PLATE
70	SHAFT ASSY (L), REEL	1			242 17761-4						
71	REEL ASSY (L)	1			242 19948						ZINC PLATE
72	WASHER, FL. (⁸⁄₃₂ x ½ x .020)	5	FIBRE		241 17770	36					
73	SHAFT ASSY (R), REEL	1			242-17771 6						
74	RING, RETAINING	2	STEEL	COMM	29650 11						ZINC PLATE
75	WASHER, FL. (.318 x ½ x .020/.015)	1	STEEL	COMM	29602-146						ZINC PLATE
76	WASHER, U	1	STEEL	COMM	241-17775 1	22					ZINC PLATE
77	ROLL PIN (.103/.099 x 7/16)	1	STEEL	COMM	241 17086 4	38	5-022-094-0437				ZINC PLATE
78	DISC, CLUTCH	1	STEEL H.R.	COMM	241 17777						HARD CHROME
79	PULLEY ASSY (R), REEL	1			242 17773-2						
80	WASHER, FL. (.172 x 7/16 x .032)	21	ST. ST	COMM	29602 102						
81	SPRING	1	MUSIC WIRE	COMM	241 17644	35					ZINC PLATE
82	NUT, WING 8-32	1	STEEL	COMM	241 17799-1	38	WS 82				ZINC PLATE
83	FLYWHEEL AND SHAFT ASSY	1			242 17778 1						
(A) 84	BALL (3/16" DIA.)	1	STEEL	COMM	241-13609	42					CHROME
85	PLATE ASSY, SUPPORT	1			242 19851-1						
86	SCREW, RRHM 8-32 x 1/4	9	STEEL	COMM	29527 15						ZINC PLATE
87	MOTOR	1			241 17674	39					
88	PLATE, MOTOR MOUNTING	1	STEEL	COMM	241 17786 2						ZINC PLATE
89	MOUNT, SHOCK	3			241-17787	40	J-2927-1-2				
90	LOCKWASHER (EXT. T) NO. 10	5	ST. ST.	COMM	29603 17	12					
91	NUT, HEX 10-32	2	STEEL	COMM	29630-16						ZINC PLATE
92	FAN	1	ALUMINUM	COMM	241-14134 1						ANODIZE
93	PULLEY, MOTOR	1	ST. ST.	COMM	241 17789 4						
94	WASHER, FL. (.328 x 9/16 x 1/16)	1	JOHNS MANSVILLE # 10	COMM	241 17790-1						
95	WASHER, D	1	SPRING STEEL	COMM	241-17794-1	43					ZINC PLATE
96	WASHER, SPRING TENSION	1	SPRING STEEL	COMM	241-17795 1	43					ZINC PLATE
97	RING, RETAINING	1	STEEL	COMM	29650-12	34					ZINC PLATE
98	DISC ASSY, CLUTCH	1			242 17791 1						
99	WASHER, FL. ([illegible] x ⅜ x .049)	3	STEEL	COMM	241 17763 2						ZINC PLATE
100	SCREW, RRHM 10-32-3/4	3	STEEL	COMM	29527-16						ZINC PLATE
101	LEVER ASSY, FOLLOWER	1			242-19931 2						
102	LINK ASSY, IDLER	1			242-19932-2						
103	HEAD AND CAN ASSY	1			242-14159	29					L2 L3
104	SCREW, RRHM 4-40 x 1/4	3	STEEL	COMM	29527-14						ZINC PLATE
105	WASHER, FL. (¹³⁄₁₁₆ x ¹¹⁄₃₂ x .032)	3	STEEL	COMM	29602-136						ZINC PLATE
106	AMPLIFIER ASSY	1			242-24296						
107	CHASSIS ASSY	1			242-20000-1						
108	TRANSFORMER, POWER	1			242-19974						T1
109	SPACER	1	STEEL	COMM	241-20098						ZINC PLATE
110	NUT, HEX 8-32	19	STEEL	COMM	29630-22						ZINC PLATE
111	TRANSFORMER, OUTPUT	1			242-19976						T2
112	REACTOR	1			242-19978						L1
113	HOLDER, FUSE	1			54619	1					
114	FUSE, 2 AMPERE	1			241-20012	1	M802				F1
115	POT. 0.5 MEG. ± 10% W	2			241-20013	2					R8, R18
116	POT. 0.5 MEG. ± 10% W	1			241-20014	2					R27
117	SWITCH, A.C. LINE	1		JAN-S-23	241-20015	3					S1
118	BUSHING	1			241-24378	13					ZINC PLATE
119	SCREW, RHM 8-32 x 1/4	5	STEEL	COMM	29522-74						ZINC PLATE
120	JACK, CLOSED CKT	2		JAN-J-641	241-20018	5					J1, J3

LIST OF MATERIAL QUANTITIES FOR ONE RECORDER REPRODUCER SOUND, RD - 173/UN

PC NO.	NAME	NO. REQ'D	MATERIAL	MATL SPEC.	CONTRACTOR DWG NO. OR SERVICE PART NO.	MANUFACTURER NAME	MANUFACTURER SERVICE PART OR DWG NO.	BUSHIPS DWG NO.	UNIT WT LB	STD NAVY STOCK NO.	REMARKS
1	CASE, CARRYING	1			242-19899-1	27					
2	GRILL, SPEAKER	1	STEEL	COMM	241-19903						MIL-E-15090B
3	BAFFLE, SPEAKER	1	MASONITE	COMM	241-19904						
4	SCREW, FIN SHANK 8-32 x 5/8	4	STEEL	COMM	241-17810-1						ZINC PLATE
5	WASHER, FL. (.172 x 1/2 x .049)	8	STEEL	COMM	29602-4						ZINC PLATE
6	LOCKWASHER, (EXT. T) NO. 8	38	ST. ST.	COMM	29603-18	12					
7	NUT, HEX 8-32	10	STEEL	COMM	29630-11						ZINC PLATE
8	SPEAKER (6" DIA. PM-3.2Ω)	1			241-19906	28	59778				ZINC PLATE
9	BOTTOM	1	STEEL	COMM	241-19908						ZINC PLATE
10	BAND, RUBBER	1	RUBBER, GUM	COMM	241-17861						
11	CORD AND PLUG ASSY	1			241-19907-1						
12	PANEL, TOP	1	STEEL	COMM	241-19910-1						MIL-E-15090B
13	SCREW, RPHM 6-32 x 1/4	2	STEEL	COMM	29529-11						ZINC PLATE
14	SCREW, RPHM 6-32 x 1/4	7	STEEL	COMM	29529-44						ZINC PLATE & MIL-E-15090B ON HD ONLY
15	WASHER, FL. (.141 x 1/4 x .010)	10	COPPER	COMM	29602-111						ZINC PLATE
16	COVER	1	PLASTIC		241-19912-1	30					MIL-E-15090B BLACK CHARACTERS
17	SCREW, RRHM 4-40 x 1/4	2	BRASS	COMM	29529-14						SATIN CHROME
18	COVER	1	PLASTIC		241-19913	30					MIL-E-15090B BLACK CHARACTERS
19	SCREW, RPHM 4-40 x [illegible]	1	STEEL	COMM	29529-46						ZINC PLATE & MIL-E-15090B ON HD ONLY
20	MICROPHONE, MAGNETIC	1			241-19914	31					MIL-E-15090B
21	KNOB	3	ALUMINUM	COMM	241-19915						ANODIZE
22	SCREW, CUP POINT SET 8-32 x 3/16	15	STEEL	COMM	29540-9						ZINC PLATE
23	KNOB, CONTROL	1	ALUMINUM	COMM	241-20207						ANODIZE
(A) 24	PLATE, NAME	1	NI-CU	42N2	*	32					BRIGHT CHROME
25	SCREW, RRHW NO. 4 x 1/4	4	STEEL	COMM	29536-3						
(B) 26	REEL AND TAPE (7" DIA.)	2		W-T-61A	241-19918	33					
27	REEL (7" DIA.)	1		W-T-61A	241-19919	33					
28	PLATE ASSY, MECH	1	STEEL	COMM	242-19840						ZINC PLATE
29	SUPT ASSY (L), REEL SHAFT	1			242-17695-2						
30	WASHER, FL. (.200 x .4375 x .036)	7	BRASS	COMM	29602-124						
31	WASHER, SPRING TENSION	11	SPRING STEEL	COMM	241-12059-1	12					ZINC PLATE
32	RING, RETAINING	4	STEEL	COMM	29651-3	34					ZINC PLATE
33	SPRING	4	MUSIC WIRE	COMM	241-17801	35					ZINC PLATE
34	SUPT ASSY (R), REEL SHAFT	1			242-17703-3						
35	CAM AND SHAFT ASSY	1			242-19847						
36	CAM ASSY	1			242-19945						
37	GROMMET	7	RUBBER	COMM	241-14213	23	#901				
38	LEVER, IDLER KICKOUT	1			241-24380						ZINC PLATE
39	LEVER ASSY	1			242-19946						ZINC PLATE
40	ROLLER	2	STEEL	COMM	241-17897-4						ZINC PLATE
41	RING, RETAINING	2	STEEL	COMM	29650-9	34					ZINC PLATE
42	SPRING	2	MUSIC WIRE	COMM	241-17802	35					ZINC PLATE
43	LINK ASSY	1			242-19930-1						
44	IDLER ASSY	3			242-17719-6						
45	WASHER, FL. (²⁴⁹⁄₂₄₈ x ⅜ x .020)	6	FIBRE		241-17722-1	44					
46	RING, RETAINING	10	STEEL	COMM	29650-10	34					ZINC PLATE
47	WASHER, SPRING TENSION	4	SPRING STEEL	COMM	241-17723-1	12					ZINC PLATE
48	WASHER, (13/16 x 1-3/8 x 1/8) CLUTCH	1	FELT		241-12145	37					
49	LEVER ASSY, FOLLOWER	1			242-19931-1						
50	LINK ASSY, IDLER	1			242-19932-1						
51	LEVER ASSY	1			242-19947						ZINC PLATE
52	LEVER ASSY	1			242-17741-3						
53	SPRING	1	MUSIC WIRE	COMM	241-12138	35					ZINC PLATE
54	SPRING	1	MUSIC WIRE	COMM	241-14252	41					ZINC PLATE
55	PINCH ROLLER ASSY	1			242-17744						
56	WASHER, FL. (.147 x .313 x .020)	1	FIBRE		241-17747	36					
57	WASHER, FL. ([illegible] x ⅜ x .020)	1	FIBRE		241-17722	36					
58	WASHER, FL. (.152 x 5/16 x .028)	1	BRASS	COMM	29602-103						ZINC PLATE
59	SCREW, RRHM 6-32 x 1/4	15	STEEL	COMM	29527-4						ZINC PLATE
60	PAD ASSY, PRESSURE	1			242-17748-2						

* USE 241-19916-7 FOR CONTRACT NOBS 74672
USE 241-19916-8 FOR CONTRACT NOBS 76188
USE 241-19916-9 FOR CONTRACT NOBS 76505

(B)

ZONE	REV	DESCRIPTION	DATE (MFR)	APP'D (MFR)	DATE (U.S.N.)	APP'D (U.S.N.)
	B	ADDED NAME PLATES	3-23-59	EFP		
	A	REVISED PART NO'S, ITEMS 24, 85	[illegible]	EFP		

REVISIONS

DATE 6-21-57
DRAWN [illegible]
CHECKED [illegible]
APP'D [illegible]
APP'D DATE

MASTER DRAWING
RECORDER REPRODUCER
(MODEL N216)
RD-173 UN
(LIST OF MATERIAL)
SCALE NONE WT CALC ACTUAL

WEBSTER ELECTRIC CO.
RACINE, WISCONSIN
242-24298
NAVY DEPT BU SHIPS DWG NO S6502 D 3313770 REV A
CONT ON SHT 3 SHT NO 4

Figure 26

ZONE	REV	DESCRIPTION	DATE	APP'D	DATE	APP'D
	A	ADDED ITEMS 241, 242	6-5-57			
	A	CHG VALUES ITEMS 149, 189				
	A	REV QUAN ITEMS 152, 164, 166				
	A	REV PART NO'S ITEMS 149, 165, 175, 189				
		192, 208, 236				
			MFR		JSN	

REVISIONS

DATE 6-21-57
DRAWN
CHECKED
APP'D
APP'D DATE

MASTER DRAWING

RECORDER REPRODUCER
(MODEL N216)
RD-173/UN
(LIST OF MATERIAL)

SCALE NONE
WT CALC ACTUAL

WEBSTER ELECTRIC CO.
RACINE, WISCONSIN
242-24298

NAVY DEPT BU SHIPS DWG NO			REV
S6502	D	3313770	8

CONT ON SHT —— SHT NO 3

Figure 27

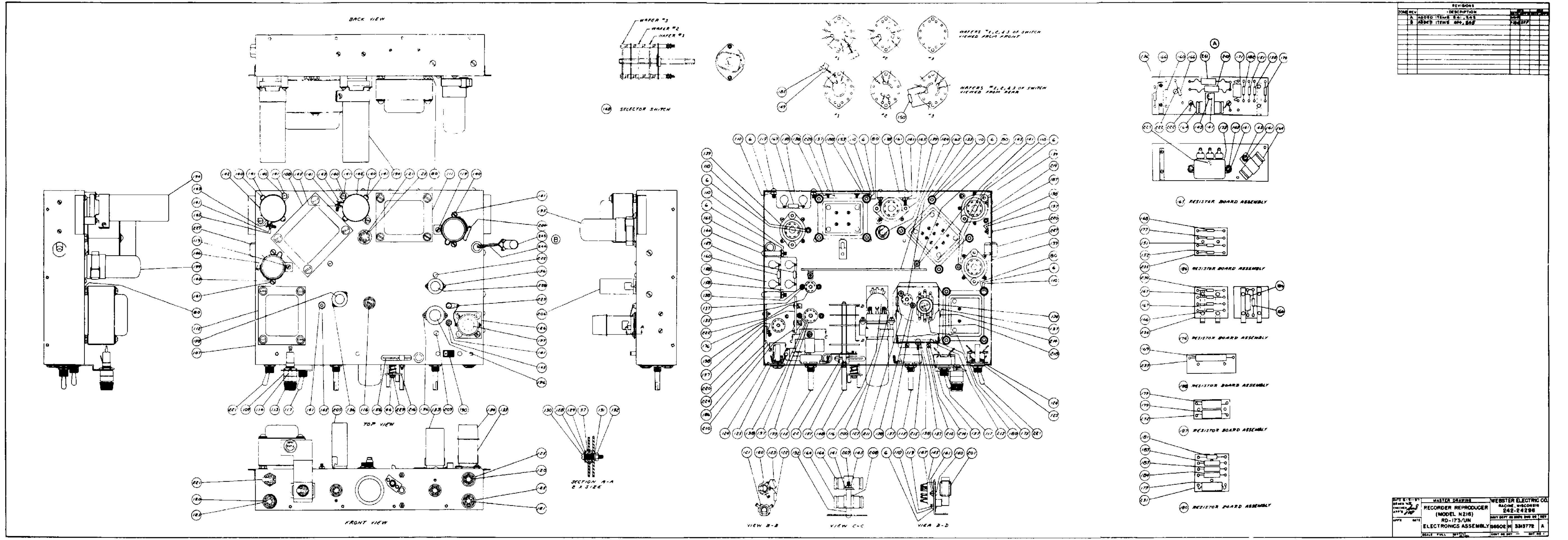
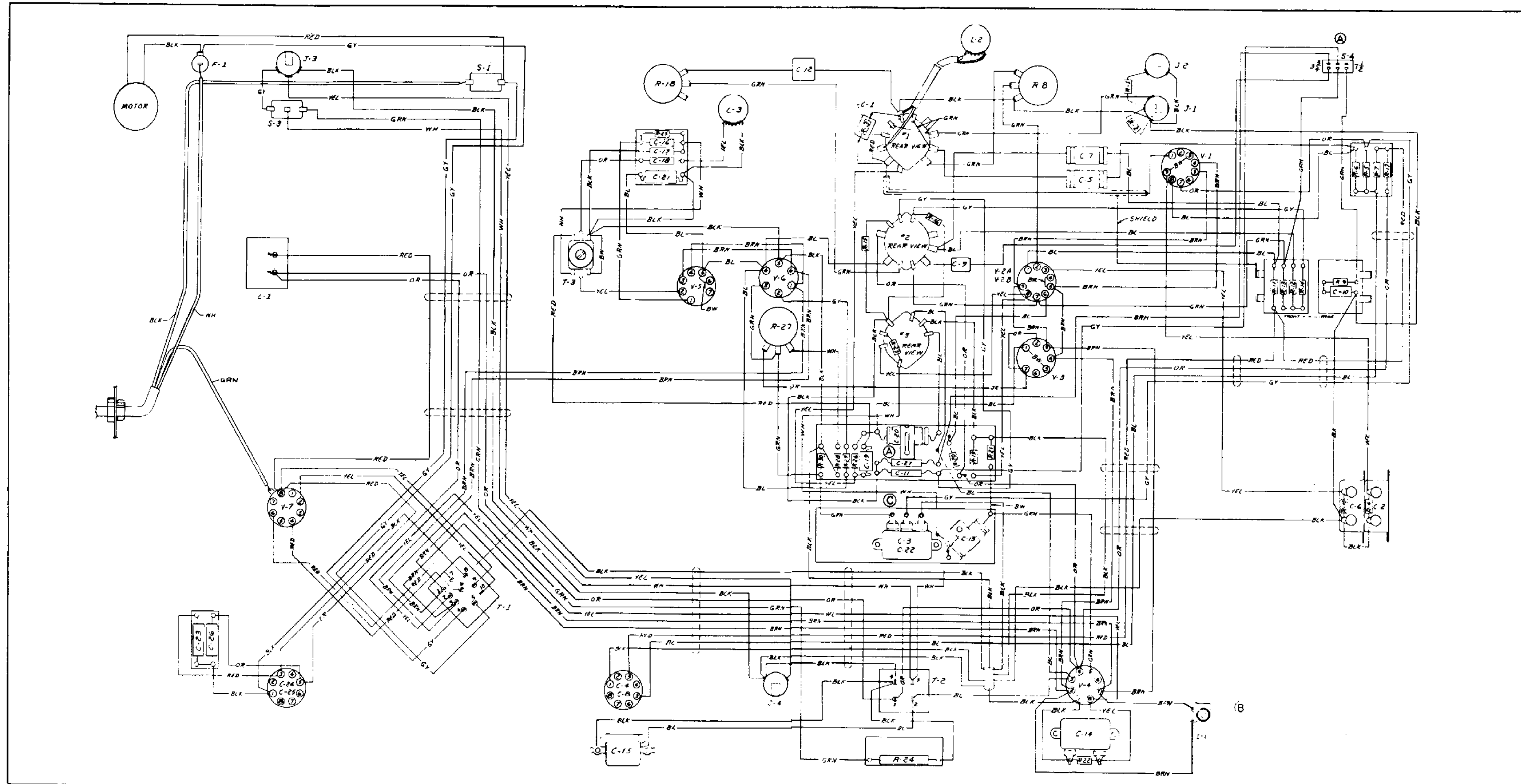

MASTER DRAWING
RECORDER REPRODUCER
(MODEL N216)
RD-173/UN
ELECTRONICS ASSEMBLY
WEBSTER ELECTRIC CO.
RACINE, WISCONSIN
242-24296
SCALE FULL
A
BACK VIEW
TOP VIEW
FRONT VIEW
SELECTOR SWITCH
SECTION A-A
VIEW B-B
VIEW C-C
VIEW D-D
RESISTOR BOARD ASSEMBLY

Figure 28



REVISIONS						
ZONE	REV	DESCRIPTION				
	A	C 27 ADDED, [illegible] WAS .05	[illegible]			
	A	SWITCH WIRING REVISED	[illegible]			
	B	ADDED [illegible]-1	[illegible]	[illegible]		
	C	C-3 + C-22 WIRING REVISED	[illegible]	[illegible]		

VOLTAGE AND RESISTANCE CHART

SYMBOL AND TYPE		PIN NUMBERS 1	2	3	4	5	6	7	8	9
V-1	VOLTS	0	N.C.	.85	12.5	12.5	N.C.	48	125	.85
5879	OHMS	0	N.C.	1 K	300	300	N.C.	INF	INF	1 K
V-2	VOLTS	112	0	1.1	12.5	12.5	118	0	1.1	12.5
5751	OHMS	INF	200	2 K	300	300	INF	480 K	2 K	300
V-3	VOLTS	0	.15	12.5	12.5	0	N.C.	.15		
5726/6AL5W	OHMS	510 K	550 K	300	300	510 K	N.C.	550 K		
V-4	VOLTS	0	12.5	255	265	0	N.C.	12.5	12.5	
6V6	OHMS	0	300	**775	**370	240 K	N.C.	300	300	
V-5	VOLTS	-.75	.4	12.5	12.5	260	260	N.C.		
[illegible]	OHMS	10 K	0	300	300	INF	INF	N.C.		
V-6	VOLTS	12.5	18	0	260	0	12.5			
6E5	OHMS	300	INF	*	INF	0	300			
V-7	VOLTS	0	320	0	275 AC	0	275 AC	0	320	
5Y3WGTB	OHMS	N.C.	INF	N.C.	175	N.C.	180	N.C.	INF	

NOTES:

1. ALL VOLTAGE & RESISTANCE MEASUREMENTS TAKEN WITH A 20,000 OHMS-PER-VOLT METER.
2. READING FOR VOLTAGE & RESISTANCE SHOULD BE TAKEN WITH THE SELECTOR SWITCH IN "RECORD" POSITION.
3. (V-1, V-2, V-3, V-5, V-7) RESISTANCE TAKEN TO CHASSIS WITH C-24 & C-25 REMOVED.
4. (*) RESISTANCE DEPENDS UPON SETTING OF R-27 (APPROX 300 K).
5. (**) RESISTANCE TAKEN TO PIN 8 OF V-7.
6. ALL VOLTAGE READINGS ARE D-C VOLTAGES EXCEPT AS NOTED.
7. ALL RESISTANCE READINGS ARE GIVEN IN OHMS; K=1000, MEG=1,000,000.
8. INF—ABBREVIATION FOR INFINITY.
9. N.C.—ABBREVIATION FOR NO CONNECTION.
10. ALL COLOR CODED WIRES ARE NO. 22 A.W.G. STRANDED EXCEPT PRIMARY POWER WIRES TO BE NO. 20 A.W.G. STRANDED. BOTH SIZES OF WIRES TO CONFORM TO SPEC. JAN-C-76, SRIR (7).
11. BARE WIRE NO. 22 A.W.G. TINNED SOLID WIRE.

WIRE CODING	
BW	BARE WIRE
BLK	BLACK
BLU	BLUE
BRN	BROWN
GRN	GREEN
GY	GRAY
OR	ORANGE
RED	RED
WH	WHITE
YEL	YELLOW

MASTER DRAWING

RECORDER REPRODUCER (MODEL N216) RD-173/UN (WIRING DIAGRAM)

WEBSTER ELECTRIC CO.
RACINE, WISCONSIN
249-24448

56502H 3313773 A

Figure 29

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D. C., *13 September 1961*

TM 11-5835-212-15/TO 31S3-2UN-181, Operator, Organizational, Field, and Depot Maintenance Manual-Sound Recorder-Reproducer Set RD-173/UN, is published for the use of all concerned.

BY ORDER OF THE SECRETARIES OF THE ARMY AND AIR FORCE

G. H. DECKER,
General, *United States Army,*
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USAR: None.

For explanation of abbreviations used, see AR 320-50.

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